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THE VIRGINIA JOURNAL OF SCIENCE

A JOURNAL ISSUED QUARTERLY BY THE
VIRGINIA ACADEMY OF SCIENCE

PROCEEDINGS FOR THE YEAR
1958 — 1959

Vol. 10, New Series September, 1959 No. 4

VOL. 10, NEW SERIES No. 4

SEPTEMBER, 1959

THE VIRGINIA JOURNAL OF SCIENCE

PUBLISHED FOUR TIMES A YEAR IN JANUARY, APRIL, JULY, AND SEPTEMBER, BY THE VIRGINIA ACADEMY OF SCIENCE

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No. 4

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THE VIRGINIA JOURNAL OF SCIENCE

VOL. 10, NEW SERIES No. 4

VIRGINIA ACADEMY OF SCIENCE

Proceedings for the Year 1958 – 1959

MINUTES OF THE THIRTY-SEVENTH ANNUAL MEETING

MAY 6, 7, 8, 9, 1959

UNIVERSITY OF VIRGINIA

CHARLOTTESVILLE, VIRGINIA

Virginia Academy of Science

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Junior Academy of Science: Thelma C. Heatwole, *Chairman*; W. W. Scott, Richard Canham, Edward R. Dyer, Jr., Virginia Ellett, Susie V. Floyd, E. Sherman Grable, John F. Hahn, Beatrice Harrington, J. C. Holmes, Franklin D. Kizer, Reuben R. McDaniel, Sidney S. Negus, H. Felix Sanders.

Visiting Scientists: J. C. Forbes, *Chairman;* Reuben R. McDaniel, S. P. Maroney, Jr., Richard S. Mitchell, L. Starling Reid, Billy W. Sloope, I. A. Updyke, H. W. K. Fitzroy, William M. Hinton.

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Awards: Boyd Harshbarger, *Chairman;* Sidney S. Negus, Paul M. Patterson.

Science Talent Search: J. C. Holmes, *Chairman;* Harold H. Garretson, Thelma C. Heatwole, Edwin S. Higgins, Franklin D. Kiser, Alfred L. Wingo.

Membership: Robert A. Clayton, *Chairman;* J. Frances Allen, G. Preston Burns, Thomas H. Christie, Imogene B. Claiborne, Dorothy Douglas Daughtrey, Kenneth R. Lawless, Henry Leidheiser, Jr.

Nominating: Edward S. Harlow, *Chairman;* William G. Guy, J. C. Forbes.

Resolutions: Zoe Black, *Chairman;* James H. Starling, Harry G. M. Jopson.

Place of Meeting: I. G. Foster, *Chairman,* A. Marguerite Risley, Percy H. Warren.

Resource–Use: E. W. Mundie, *Chairman;* A. H. Anderson, Robert S. Bailey, Samuella Crim, H. S. Mosby, George B. P. Mullin, Charles E. Packard, E. E. Rodger, D. S. Wallace, Alfred L. Wingo.

History of Science in Virginia: I. G. Foster, *Chairman;* Edwin Cox, William G. Guy, Sidney S. Negus, Joseph K. Roberts, Ivey F. Lewis.

Section Representatives: Carl W. Allen, Isabel Boggs, Mary Leigh Beach, William M. Reams, Charles C. Clayton, Charles Turner, R. M. Hubbard, Joseph K. Roberts, Ebbe Hoff, Frank A. Geldard, Samuella Crim, Boyd Harshbarger.

LOCAL COMMITTEE ON ARRANGEMENTS

General Chairman: Mr. William D. Gresham, Jr., Assistant Administrator, University Center in Virginia, Richmond, Virginia.

Housing: Lynn D. Abbott, Jr., *Chairman,* Medical College of Virginia, Richmond, Virginia.

Junior Academy: Virginia Ellett, *Chairman,* Thomas Jefferson High School, Richmond, Virginia.

Registration: Jack D. Burke, *Chairman*, Department of Biology, University of Richmond, Richmond, Virginia.

Public Information: Fontaine C. Armistead, *Chairman*, Virginia Polytechnic Institute for Scientific Research, 2820 Grove Avenue, Richmond, Virginia.

Commercial Exhibits: E. G. Cogbill, *Chairman*, Research Laboratories, American Tobacco Company, Petersburg Pike, Richmond, Virginia.

Meeting Rooms and Equipment: Lewis C. Goldstein, *Chairman*, Department of Biology, Richmond Professional Institute, Richmond, Virginia.

Entertainment for Ladies: Henry Leidheiser, Jr., *Chairman*, 5803 Fitzhugh Avenue, Richmond, Virginia.

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MINUTES OF THE COUNCIL MEETING
MAY 7, 1959

President Forbes called the meeting to order with the following Council Members and Section representatives present: Lloyd C. Bird, R. A. Bradley, R. T. Brumfield, M. E. Carver, Walter S. Flory, Jr., T. E. Gilmer, Jr., J. W. Griswold, W. G. Guy, Boyd Harshbarger, J. T. Hack, Thelma Heatwole, William Hinton, H. H. Hobbs, J. C. Holmes, G. W. Jeffers, M. A. Kise, C. F. Lane, S. P. Maroney, Jr., S. S. Negus, B. A. Niemeier, P. M. Patterson, M. B. Rowe, W. W. Scott, F. F. Smith, J. J. Taylor, W. B. Wartman, Frank Vingiello.

Mr. Holmes reported much interest in Science Fairs in southwestern Virginia and discussions arose as to how to reach and interest the science teachers more effectively. It was decided that the President send letters to Academy members associated with the five science summer institutes asking them to encourage the science teachers from Virginia and inform them about our Junior Academy and Science Talent Search. This was put in the form of a motion by Dr. Guy and passed.

President Forbes reported the request to N. S. F. for funds to support the summer research grants for faculty members of Virginia colleges was not approved but that the visiting science program was approved. This is to be administered by the University Center in Virginia, Inc. The center requested that a committee be set up by the Academy to screen and recommend to the Center nominations that are made by the various colleges.

President Forbes suggested the following persons representing different fields of science with the idea that none would be far from Richmond, as follows: Ira Updike, S. P. Maroney, Billy Sloope, Reuben McDaniel, Richard Mitchell and Starling Reed.

Dr. Guy moved that the incoming president, Dr. Hinton, appoint this committee with President Forbes a member. This motion was passed.

Dr. Forbes announced the recipients of the Goethe Travel Award as Mr. Robert Stacey and Mr. Aaron O'Brier, both of V. P. I.

Under new business, President Forbes announced that Dr. E. C. Hoff will meet with the Council on Saturday morning and present a survey of the conclusions from the discussions of the conference on the improvement of college science teaching.

The question arose as to whether $50 of the Goethe contributions should be continued to be applied to Student Travel to Academy meet-

ings as long as they were received. It was informally agreed that this would be done.

Foley Smith reported the annual audit had been made and reported briefly on the Academy's finances. Mr. Smith then read the Trustee's report.

President Forbes reported he had been invited to attend the Director's meeting of the 1959-60 Academy Science Programs in Washington on May 11 and Council felt he should do so.

President Forbes read the letter from Dr. Brumfield resigning the editorship of the Virginia Journal of Science.

Dr. Hobbs moved that we accept his resignation with regret and with appreciation for his outstanding services. This motion was passed.

President Forbes then read a letter from Mr. Lane resigning his position as Managing Editor of the Journal. Dr. Hinton moved we accept his resignation with appreciation for his services. This motion was passed.

Dr. Guy moved that Council extend its appreciation to Dr. Harshbarger for his continuing efforts in trying to obtain money for the Teacher-Student Conference and endorses the continuance of his efforts in this endeavor. This motion was passed.

Mr. Lane pointed out the need for a permanent storage place for the back issues of the Journal.

Dr. Jeffers stated that the State Department of Education had sent out a Statement of Policy, an item of which, curtailed students leaving school during the school week. Mrs. Heatwole said that exceptions were made for important meetings such as the Junior Academy meetings.

Dr. Bradley emphasized the need to provide housing to college and graduate students in attendance at Academy meetings at a low rate. Discussion followed with a number of suggestions but no decisions were made.

There being no further business, the meeting was adjourned.

—Paul M. Patterson, *Secretary*

MINUTES OF THE ANNUAL ACADEMY CONFERENCE MAY 7, 1959

President Forbes presided at 8 p.m., May 7, 1959, in Monroe Hall.

The Committee reports were presented and are published elsewhere in this issue. It is noted that Dr. Brumfield's report as Editor of the Virginia Journal of Science showed that expenditures were over income. Dr. Harshbarger moved that the incoming President, Dr. Hinton, be instructed to appoint a committee to look into the finances of the Journal with a view of making it solvent. This motion was passed.

—Paul M. Patterson, *Secretary*

MINUTES OF THE VIRGINIA ACADEMY OF SCIENCE ASSEMBLY MAY 8, 1959

President Forbes presided May 8 at Cabell Hall.

Greetings were given to the incoming President, Dr. William Hinton. He then introduced President-elect Edgar F. Shannon of the University of Virginia, who cordially extended greetings to the Academy. President Forbes then called on Dr. Raymond L. Taylor, Associate Administrative Secretary of the AAAS, who brought greetings to the Academy from that organization.

President Forbes asked Mrs. Heatwole to make the following announcements:

The Section of Bacteriology gave its Junior Academy of Science award in the field of microbiology to Mr. William Ridenhour, of William Fleming High School, Roanoke, and the Section of Engineering gave its Engineering Award to Mr. Lilliwhite. The Teacher-Sponsored Scholarships were awarded as follows:

The University of Virginia
Paul Caldwell, Woodrow Wilson Junior High School
Alternate: Mrs. Ruth Painter, William Fleming High School

The College of William and Mary
Mrs. Garland Conn, Newport News
Alternate: Mr. Morris Tischler, Fairfax.

Dr. Edmund Berkeley, of the University Center in Virginia Inc., explained the administration of the Visiting Scientist Program where the National Science Foundation has granted $6450 to provide a science speaker for a period of two days to each of the colleges in Virginia.

The Virginia Academy Distinguished Service Award was conferred on Senator Lloyd C. Byrd by President Forbes. The J. Shelton Horsley Research Award was presented to Dr. Dorothy L. Crandall of Randolph-Macon Woman's College by Research Committee Chairman, Dr. Ralph A. Bradley.

Dr. I. G. Foster presented an invitation from the Virginia Military Institute for the place of meeting of the Virginia Academy of Science in May, 1961. This cordial invitation was unanimously accepted.

Dr. Nolan Rice presented the Academy Resolutions which appear elsewhere in this issue.

Dr. Walter Flory, Jr., Chairman of the Nominating Committee, presented the following slate of officers: Secretary: P. M. Patterson, Treasurer: Foley F. Smith, Assistant Secretary-Treasurer: W. B. Wartman, Jr., Council Members: Robert C. Yates, 5 year term, Harry G. M. Jopson, 4 year term, President-Elect: Dr. Wilson Bell.

This slate was unanimously adopted.

President Forbes now introduced the speaker of the evening, Mr. S. I. Gale, of the American Cyanamide Company, who spoke on the subject: "Chemistry on a Cosmic Scale," a lecture enthusiastically received by all.

Dr. Forbes then thanked his Council, officers, and committees and others of the membership for their cooperation, then turned the meeting over to the new President, William Hinton. After a few appropriate remarks, President Hinton, on behalf of the Awards Committee, approved by Council, conferred upon Dr. Forbes the framed citation reading in part "For his many contributions to the advancement of Science, teaching, and scientific research in Virginia."

—Paul M. Patterson, *Secretary*

MINUTES OF THE COUNCIL MEETING MAY 9, 1959

President Hinton called the meeting to order with the following present.

Wilson B. Bell, R. T. Brumfield, J. C. Forbes, W. G. Guy, Ed Harlow,

Thelma Heatwole, H. H. Hobbs, E. C. Hoff, G. W. Jeffers, P. M. Patterson, F. F. Smith, W. B. Wartman.

Dr. Hoff reported on the conference held in March at M.C.V. on the improvement of college science teaching. His report centered around research by faculty, promotion of research with students and the character of the curriculum.

The subject as to how the Committee "To assist the State Board of Education in Improving the Teaching of Science and Relieving the Shortage of Scientists and Engineers" might cooperate in Dr. Hoff's venture. Mr. Harlow moved that this committee be placed under the authority of the Long-Range Planning Committee. This motion was passed.

Dr. Jeffers moved that Council express its confidence in and support of the Science Teaching Conference, initiated by M.C.V. under the direction of Dr. Hoff. This motion was passed.

Mr. Harlow pointed out that one of the staff of the Research Laboratories of the American Tobacco Company had taught an advanced course in chemistry at Thomas Jefferson High School in Richmond which had been well received. He then suggested that the Academy may help high schools approach industries seeking instructors for advanced courses in Science. Council looked with favor upon the suggestion and felt that this subject should be brought to the attention of the "Committee on Education."

With respect to the Committee to Assist the University Center in Virginia, Inc., President Hinton reported that he would appoint the Committee on Selections as recommended by retiring President Forbes with Forbes as Chairman.

With respect to finding an editor for the Journal and to study its financial condition, President Hinton felt this should be done by a Committee. It was recommended that this Committee consist of Drs. Brumfield and Hobbs.

Council recommended, in appreciation of the services of Dr. Mary Humphreys, Associate Editor of the Journal, that her outstanding contribution be recognized appropriately.

Dr. Brumfield recommended that, in the future, all abstracts of papers presented at the Academy by submitted in duplicate, and that second copy be made available for press coverage.

Mrs. Thelma C. Heatwole offered to continue as Chairman of the Junior Academy of Science Committee, in spite of the fact that she will be out of the State most of the time, if a Co-Chairman was appointed to work with her. This suggestion was approved. There followed apprreciation of

her valuable work with the "junior scientists" during her chairmanship for the past 7 years.

Council went on record in expressing its appreciation for the services of Drs. Flory and Bradley, who leave Council and to Dr. Forbes for his services as President.

—Paul M. Patterson, *Secretary*

TREASURER'S REPORT

CONSOLIDATED FUND BALANCE SHEET

DECEMBER 31, 1958

ASSETS

GENERAL FUND:			
Cash in bank		$ 5,432.60	
Investments – at cost		2,445.95	
Due from Research Fund		40.00	
Total General Fund			$ 7,918.55
RESEARCH FUND:			
Cash in bank		$ 554.23	
Due from special trust fund (temporary investment)		1,100.00	
Total Research Fund			1,654.23
TRUST FUND PRINCIPAL:			
Cash on deposit		$ 22.24	
Investments – at cost:			
United States Savings Bonds	$ 3,000.00		
Commercial bonds	3,025.00		
Stocks	10,805.90	16,830.90	
Total Trust Fund Principal			16,853.14
Trust Fund Income			
Cash on deposit			460.75
SPECIAL TRUST FUND PRINCIPAL:			
Cash on deposit		$ 10.05	
Investments – at cost:			
United States Savings Bonds	$ 720.00		
Stocks	1,974.43	2,694.43	
Total Special Trust Fund Principal			2,704.48
SPECIAL TRUST FUND INCOME:			
Cash on deposit			71.50
			$29,662.65

LIABILITIES AND FUND BALANCES

GENERAL FUND:		
Advance payment of dues	$ 54.00	
James River Basin Fund	335.60	
Fund Balance	7,528.95	
Total General Fund		$ 7,918.55
RESEARCH FUND:		
Due to General Fund	$ 40.00	
Fund balance	1,614.23	
Total Research Fund		1,654.23
TRUST FUND PRINCIPAL:		
Fund balance	$16,853.14	
Total Trust Fund Principal		16,853.14
TRUST FUND INCOME:		
Fund balance		460.75
SPECIAL TRUST FUND PRINCIPAL:		
Due to Research Fund	$ 1,104.84	
Due to James River Project	1,600.00	
Total Special Trust Fund Principal		2,704.48
SPECIAL TRUST FUND INCOME:		
Fund balance		71.50
		$29,662.65

TABULATION OF REGISTRATION

Section	Members	Non-Members	Totals
1. Agricultural Sciences	16	22	38
2. Astronomy, Mathematics & Physics	36	20	56
3. Bacteriology	10	5	15
4. Biological Sciences	80	45	125
5. Chemistry	67	30	97
6. Education	7	1	8
7. Engineering	10	9	19
8. Geology	12	8	20
9. Medical Sciences	17	9	26
10. Psychology	36	25	61
11. Science Teachers	10	0	10
12. Statistics	10	11	21
No Section Preference	12	34	46
Totals	323	219	542
Junior Academy of Science Registration			360
Total Registration 1959 Meeting			902

FINANCIAL STATEMENT

VIRGINIA JOURNAL OF SCIENCE

May 1, 1958 – April 30, 1959

RECEIPTS:

Academy Subsidy – Members	$3,253.81
Advertising	323.40
Subscriptions	622.95
Transferred from Savings	1,000.00
Miscellaneous	1,096.30
Total of all Receipts	$6,296.46

EXPENDITURES:

Reprints	$ 458.21
Printing	5,888.04
Postage	90.03
Stenographic	14.40
Freight	46.23
Miscellaneous (Telephone calls)	10.05
Petty Cash (See Analysis below)	65.00
Total all Expenditures	$6,571.96

STATEMENT OF CASH ACCOUNT:

Cash in Checking Account – May 1, 1958	$2,291.37
Total Receipts for Year	6,296.46
Total Cash in Checking Acc. during year	8,587.83
Less Total Expenditures for Year	6,571.96
Cash per Checkbook – April 30, 1959	2,015.87
Add Cash on Hand – Petty Cash Fund	13.46
Add Balance in Savings Account	816.10
	$2,845.43

Audited by Willard G. Leeper, May 5, 1959.

VIRGINIA JOURNAL OF SCIENCE

The JOURNAL is utilized as an organ of publication by many members of the Academy, especially the Biology Section. As a result, there is a fair back-log of papers reporting the results of research. Few review articles have been submitted, however, and the help of the membership in soliciting this type of paper is requested.

— R. T. Brumfield

LONG RANGE PLANNING

Your committee has had one formal meeting during the year. No specific matter has been referred to the Long Range Committee by the Council.

The status of each of the several continuing projects is as follows:

1. The proposal of Mrs. Thelma C. Heatwole that an evaluative study be made of the Virginia Science Talent Search has not been abandoned even though the National Science Foundation could not support it. A subcommittee is now exploring other possibilities in the hope that financial aid for a study will be forthcoming.

2. The Dismal Swamp Study, under the direction of Dr. J. J. Baldwin, Jr., is making progress although it is not yet possible to suggest a completion date.

3. President Forbes has made satisfactory arrangements with State Superintendent Davis Y. Paschall for the distribution of surplus Jamestown Festival Booklets to the schools of the State. When this is accomplished we can say that the Jamestown Festival Project has been terminated.

— G. W. Jeffers

RESEARCH COMMITTEE

During the period May 1, 1958, to May 1, 1959, the following grants were made:

B. R. Woodson, Jr., Department of Biology, Virginia State College, for research on the desmids and their distribution in Virginia $222.00

Jesse C. Thompson, Jr. and Paul M. Patterson, Department of Biology, Hollins College, for the purchase of one pneu-

matic deFonbrune micromanipulator for use in a number of research proposals	435.00
Total grants	657.00
J. Shelton Horsley Research Award	100.00
Total Expenditures	757.00

— R. A. Bradley

VIRGINIA JUNIOR ACADEMY

The Annual Meeting VJAS was held at the University of Virginia on May 7 and 8. One hundred and sixty-four exhibits which illustrated research projects were qualified at the JUNIOR SCIENCE DAYS for exhibit at the annual meeting.

The guest speaker at the Awards Hour was Dr. R. N. DuPuis, vice-President-Research, Philip Morris, Inc.; *Subject*: SCIENCE AND THE HUMAN MIND.

The following awards were announced at the Awards Assembly:

CLUB EXHIBITS

	Exhibit	Exhibitor	School	Sponsor
1st Place	The Role that Woodrow Wilson Junior Plays in The S. W. Roanoke Community Health	Woodrow Wilson Junior H. S. Science Club		Paul N. Caldwell
2nd Place	Many Hands of Science	Victoria Junior Science Club		Mrs. Virginia Cole
3rd Place	Projects of the Electro-Rocket Society	Warwick H. S. Science Club		Miss Dawn Irvine

HONORABLE MENTIONS

Avocations Related to Science	Thomas Jefferson H. S. Science Club		Miss Virginia Ellett
Science for Everyone	Newport News H. S. Science Club		Miss Susie V. Floyd

BIOLOGY

1st Place	An Extended Study of Anoxia as a Cause of Congential Deformities	Baird, James K.	Wm. Fleming	Mrs. Painter
2nd Place	Comparison of Chemical and Radiological Mutations	Ridenhour, Bill	Wm. Fleming	Mrs. Painter
3rd Place	Radiosensitivity in Mice	Abbott, Sally	Jefferson Sr.	Miss Via

3rd Place	Radiosensitivity in Mice	Abbott, Sally	Jefferson Sr.	Miss Via

HONORABLE MENTIONS

Materials for Paradermal Study of Leaf Venation	Roane, Ernest	Armstrong	Mrs. Gadsden
Testing the Effects of Gibberellic Acid on Algae	Wheeler, Daniel D.	Fairfax	Mr. Klimepeter
Induced Ovulation and Regeneration in Rana Pepiens	Carter, Symore	Maggie Walker	Mr. Powell
Life Cycle of the Water Mold	Dail, Peggy	Newport News	Miss Floyd
Evolution of the Gastropod Shell	Harrison, Ben	Hampton	Miss Bully
Experimental Breeding of Frogs	Hunter, Dale	John Marshall	Miss Hill
My Inheritance	Kersey, Sandra	Hampton	Miss Bully
Red No. 32	Youmans, Marjorie	Fairfax	Mr. Tischler
A Study of Oral Bacillus and Lactobacillus Counts and Their Relation to Dental Caries	Parker, Bobby	Bedford	Mrs. Thaxton
The Effects of Tranquilizers and Stimulants on White Mice	Turner, Ann	Bedford	Mrs. Thaxton
The Production or Yellow Magic Penicillin	Lieurance, John	McLean	Mrs. Fisher
Sea Life	Churchill, Charlotte	Osburn	Miss Smith
A Bio-Assay of Vitaminal Blood Serum	Humbley, Bessie	Maggie Walker	Mr. Black
Hypothermia	Jobin, Gary	Washington-Lee	Mr. North

PHYSICS

1st Place	Coefficient of Restitution	Hoyle, Pete	Newport News	Miss Floyd
2nd Place	Dispersion Relationship of Falling Liquids	Fisher, Stephen	Fairfax	Mr. Williams
3rd Place	Thermocouple	Young, Robert	Bassett	W. S. Waid

HONORABLE MENTIONS

Seipac	Cheek, Thomas B.	Warwick	Miss Irvine
Radio Astronomy	Bailey, Gordon	Jefferson	Miss Dickerson
The Newtonian Constant of Gravitation	Harrison, Harold	Washington-Lee	Mr. North
Can the Wear Factor of Industrial Diamonds be Increased	Brown, Mary	McLean	Mr. Rumbough
Wilson Cloud Chamber	Smith, Russell Jones, Harry	Douglas Freema	Mrs. Perkins
Electrostatic Accelerator	Rumble, Vernon	Hampton	Mrs. Thomas Mr. Rose

CHEMISTRY

1st Place	Paper Chromatography — A technique Applied in Medical Research	Weiler, Harold	Fairfax	Mr. Tischler
2nd Place	A Novel Atmospheric System for Space Flight	Lecky, W. Ralston	Thos. Jefferson	Miss Ellett

	Space Flight			
3rd Place	Determination of Field Polarization in Solutions	Shumate, Paul, Jr.	Fairfax	Mr. Tischler

HONORABLE MENTIONS

Qualitative Protein Analysis with Protein Chromatography	Burtchaell, Wm.	Fairfax	Mr. Tischler
Reactions to Contrast of Moon Temperatures	Tanner, Lynne	Hampton	Miss Bully & Mr. D. E. Rose
Practical, Chemical & Mechanical Methods for Cleaning Laboratory & Industrial Apparatus	Smith, Walter	Hampton	Mr. Dale Rose
The Comparison and Effect of Nicotine	Mendelson, Elaine	Woodrow Wilson (Portsmouth)	Mrs. Annie Edwards
The Study of the Acid Soluble Pigments in Mollusca of the Species Pteria Colymbus and Strombus Alatus	Rose, Anne C.	Thos. Jefferson	Miss Ellett
Crystal Orientation and its Effects on the Rate of Chemical Reaction	Long, Patricia A.	Thos. Jefferson	Miss Ellett
The Study of PH Changes in the Course of Acid-Base tration	Johnson, Frances	Maggie Walker	Frederick Black
A Qualitative Study of Commercial Fertilizer	Ross, Norman	Maggie Walker	Frederick Black

MISCELLANEOUS

1st Place	Rocket Power	Rasberry, Stanley	Falls Church	Miss N. Shugrow
2nd Place	Linear Programming-Graphic Method	Boyd, Richard N.	Washington-Lee	E. M. North
3rd Place	A Study of Topological transformations and Maxima and Minima by Soap Film Experiments.	Moss, Albert	Maggie Walker	Mrs. B. Harrington

HONORABLE MENTIONS

An Investigation of the Evolution of Human Culture	Broaddus, Paul	Osburn (Prince Wm. Co.)	Miss Smith
A Study and Comparison of Modifications of the B-7 Auto-Gyro	Smith, Strother	T. Jeferson	Miss Ellett
Studies to Determine the Effects of Distraction on Grammar School Children	Ramsey, Patsey	Martinsville	Mr. Sanders
An Astronomical Telescope	Schmidt, Dorn & Nelson, Jerry	McLean	Mrs. Walsh

TEACHER-SPONSOR SCHOLARSHIPS; *University of Virginia;* Paul Caldwell, Woodrow Wilson Junior High School; Alternate: Mrs. Ruth Painter, William Fleming.

College of William and Mary; Mrs. Garland Conn, Newport News; Alternate: Mr. Morris Tischler, Fairfax.

Microbiology Award: Bill Ridenhour, William Fleming; Honorable Mention: Barbara Sink, Boiling Springs High School.

Engineering Award: Malcolm A. Lillywhite, Washington-Lee High School. *E. C. L. Miller Award*: Newport News Science Club.

Major W. Catesby Jones Award: Bill Ridenhour, William Fleming High School.

Honorary Memberships, American Association for Advancement of Science: Rick Owen, III, Thomas Jefferson High School, and Nancy Stoller, Newport News High School.

Honorary Memberships, Virginia Academy of Science: Frances Johnson, Maggie Walker High School, and Albert Moss, Maggie Walker High School.

SCIENCE TALENT SEARCH

The fourteenth Virginia Science Talent Search was conducted in cooperation with the National Science Talent Search. Of the one hundred and forty-four high school students who entered, eight received National Honorable Mention.

Our own reading committee considered all of the Virginia entries and selected the top forty-five as finalists to come before interviewing committees at the Charlottesville meeting of the Academy. The list of fifteen Winners and those receiving Honorable Mention will be attached to this report. All cooperating colleges and universities have received a list of the finalists. At the conclusion of this meeting they will be sent the list of Winners and Honorable Mentions.

The director is grateful for the assistance of the following who served on the reading committee: Dr. Mary E. Kapp, Dr. Jackson J. Taylor, Dr. E. Clifford Nelson, Dr. Billy W. Sloope, and Dr. William E. Trout, Jr.

Thanks are also due to the judges who helped with interviewing the finalists: Dr. W. Allen Powell, Dr. Edwin S. Higgins, Mr. Alfred L. Wingo, Dr. Mary E. Kapp, Dr. Ralph Singleton, Dr. R. M. Schatz, Dr. Billy

Frye, Mr. Edgar V. Russell, Jr., Dr. J. N. Dent, and Dr. Harold H. Garretson.

— J. C. Holmes

WINNERS OF THE FOURTEENTH VIRGINIA SCIENCE TALENT SEARCH,

1. Baird, James Kern
2603 Tenth St. N. W.
Roanoke, Virginia

2. Bowler, Alicia Inez
302 Eighth St., N. W.
Charlottesville, Virginia

3. Evans, James Everett
1424 N. 12th St.
Arlington, Virginia

4. Grant, Donald Edd
5601 N. 36th St.
Arlington 7, Virginia

5. Hacker, Carl Sidney
218 Chesterfield Rd.
Newport News, Virginia

6. Harrison, Benjamin
4609 Victoria Blvd.
Hampton, Virginia

7. Hogan, Edward Merrick
3127 N. Pollard St.
Arlington, Virginia

8. Lintner, Michael Alan
3425 South Utah Street
Arlington 6, Virginia

9. Newman, Robert Chapman
1823 N. Nelson St.
Arlington, Virginia

10. Omohundro, Richard Eugene
2318 North Upton Street
Arlington 7, Virginia

11. Schmidt, Dorn Lewis
90 Wrightson Drive
McLean, Virginia

12. Shaker, Richard John
3106 N. 7th Street 1
Arlington, Virginia

13. Sounders, John Martin
Rt. No. 1, Box 425
McLean, Virginia

14. Tomes, Charles Forrest
8359 Halesworth
Richmond 25, Virginia

15. Winsor, Niels Karl
3017 — 4th Street
Arlington 1, Virginia

VIRGINIA SCIENCE TALENT SEARCH.
HONORABLE MENTION IN THE FOURTEENTH

1. Baroody, Roger Anis
203-D East Nelson Street
Lexington, Virginia

2. Brewer, William F.
4 Eppard Street
Falls Church, Virginia

3. Broaddus, Paul Farwell
Route No. 2, Box 128
Nokesville, Virginia

4. Cassada, Thomas Edward

532 Woods Ave.
Roanoke, Virginia

5. Donohew, Jack Norman
4311 North 24th Street
Arlington 7, Virginia

6. Dowling, Walter J.
Laurel Ridge Road
Vienna, Virginia

7. Fisher, Stephen David
Box 418, Rt. 1
Fairfax, Virginia

8. Gearhart, Clayton Alan, Jr.
Route 3 — Box 180
Fairfax, Virginia

9. Hambrick, David Paul
1401 Cove Rd. N. W.
Roanoke, Virginia

10. Hamilton, MacKenzie Lee
3335 N. Randolph Street
Arlington, Virginia

11. Harrison, Harold Roger
2400 N. Nelson St.
Arlington, Virginia

12. Long, Patricia Ann
3603 Missouri Ave.
Richmond 22, Virginia

13. Mason, James Porter
Eagle Rock, Virginia

14. McMurray, Morland John
1329 Rugby Road
Charlottesville, Virginia

15. McNally, James Klueh
Quarters 407 A.
Fort Belvoir, Virginia

16. Parrish, Russell Vaughan
2000 Roanoke Ave.
Newport News, Virginia

17. Patterson IV, John Laird
417 Gilbert Street
Hampton, Virginia

18. Rasberry, Stanley Dexter
201 Lawrence Drive
Falls Church, Virginia

19. Remington, Bruce
11 Tauxemont Road
Alexandria, Virginia

20. Roop, Joseph McLeod
Route 1
Clifton, Virginia

21. Rose, Anne Clairborne
1010 Westwood Ave.
Richmond 27, Virginia

22. Rucker, Diane Elise
3139 — 18th St., North
Arlington 1, Virginia

23. Salmon, William Irwin
800 N. Wayne St., No. 304
Arlington 1, Virginia

24. Shumate, Paul William
Rt. No. 3, Box 540
Fairfax, Virginia

25. Starbird, Susan Evelyn
2401 N. Taylor Street
Arlington 7, Virginia

26. Stoller, Nancy Elaine
37 Alleghany Rd.
Hampton, Virginia

27. Turpin, William Craig
1410 Noland Road
Falls Church, Virginia

28. Welles, Judith Evelynne
Box 350R — Rt. No. 1
Oakton, Virginia

29. Wharam, Moody Dewitt
1405 N. Wakefield Street
Arlington, Virginia

30. Wood Jr., Gilbert Nathaniel
R. F. D. No. 2
Farmville, Virginia

VIRGINIA FLORA

Members of the Committee keep plugging away in spite of academic responsibilities. Professor Freer continues his activities in the Central Blue Ridge area, Dr. Patterson is active in his investigation of the moss flora. Different members of the Committee have continued to promote interest in the flora by means of illustrated lectures and journal articles. A second edition, slightly revised, of the bulletin on Virginia Ferns and "Fern Allies" has been issued and a third edition of the bulletin on Poisonous Plants will be available in May. Dr. Clyde F. Reed of Baltimore has made a special study of the ferns of the Northern Neck area. His data giving details of his field investigations are presented in a paper in American Fern Journal, Vol. 49, pages 30-36. This is a welcomed contribution. Massey has been granted the privilege of continuing his work on the State flora at V.P.I. as Professor of Botany Emeritus, Curator of the Herbarium. Freed of academic duties he will give his entire attention to his objective – Flora and Economic Botany of Virginia – and extending the herbarium which now contains some 25,000 specimens from all parts of the State.

– A. B. Massey, Chairman

PLACE OF MEETING

The Virginia Military Institute has cordially invited the Virginia Academy of Science to hold its 1961 meeting at Lexington, Virginia.

– I. G. Foster

BUSINESS MEMBERSHIP

The Academy has eleven business members. Efforts were made to obtain additional business members to support the work of the Academy but no concentrated campaign was initiated. It is the intention of the Committee to make a more all-out effort during the coming year.

– E. S. Harlow

SCHOLARSHIP

No senior high school student, who is considered by his teachers as having the ability and aptitude to continue his formal education, need be prohibited nowadays from attending college by financial considerations

alone. This is *especially* true if the high school senior is proficient in biology, chemistry, physics, and mathematics as well as in subjects like English and history. Added to this proficiency, however, must be the initiative and determination on the part of the needy student to find out for himself how he can help his parents to make possible his college education.

During the past year, the scholarship committee of the Academy has had only 32 high school seniors ask its advice about college scholarships. Fortunately all but one of these had definite aptitudes for scientific careers and were recommended to the colleges of their choices for financial aid. All of them received scholarships ranging from $200 to $1200. In no case, did the committee recommend a student to more than one college.

One reason why this committee is not consulted more is probably because high school teachers are doing such good jobs in securing college scholarships for their better students who need financial aid. There are also many teachers of scientific subjects in colleges who are quietly seeking brilliant high school students for their respective colleges. They learn of them by way of the State Science Talent Search and the Virginia Junior Academy of Science activities. Often a top winner at the annual science exhibit of the Junior Academy and/or the Talent Search is offered as many as six scholarships. Academy members are doing exceptionally well in securing financial aid for high school seniors to continue their scientific studies in colleges. This particular committee, however, cannot claim much of the credit.

— Sidney S. Negus

RESOLUTIONS

1. Whereas the concept of organic evolution has contributed greatly to the advancement of science and promises even greater advancement for the future, and

Whereas the year 1959 marks the one hundredth anniversary of the publication of the Origin of Species by Charles Darwin, and

Whereas the Virginia Academy of Science was instituted for the discovery and dissemination of scientific knowledge,

Therefore be it resolved that the Virginia Academy of Science hereby recognizes this monumental work in tribute to the man and in commemoration of the date.

2. Be it further resolved:

That the Academy records with sorrow the loss by death of the followings members: Dr. Edwin M. Betts, Dr. J. K. Finnegan, Mrs. Lillian A. Hughes, Mrs. W. R. Nance, and Mr. J. Worth Pence, and

3. That the Academy extends its thanks in grateful appreciation to its host, the University of Virginia, and for the exceptionally fine facilities and arrangements for this meeting, and especially for the tea, and to the Local Committee on Arrangements headed by Dr. S. P. Maroney, Jr., and his able assistants, namely: Drs. Jacques Rappaport, William C. Lowry, Richard McKinsey, Kenneth Llyod, Bartholomeus Van't Riet, and Starling Reid, and

4. That the Academy acknowledge with appreciation the efforts of commercial and educational exhibitors, and

5. That the Academy is deeply indebted to President John Campbell Forbes for his tireless, enthusiastic, and devoted leadership and to the other officers both General and Sectional for their whole-hearted cooperation in making this a highly successful meeting.

Everett H. Ingersoll
George W. Jeffers
Nolan E. Rice, *Chairman*

MINUTES OF THE SECTION MEETINGS

AGRICULTURAL SCIENCES

1. A 26-YEAR WEATHER SUMMARY AT HOLLAND, VIRGINIA.
D. L. Hallock; *Virginia Agricultural Experiment Station.*

Certain temperature and precipitation records obtained at the Tidewater Research Station were presented. Generally, rainfall distribution and temperatures are favorable for good crop production. Extreme temperatures of 105°F and -3°F occured during the 26-year period. The hottest month is generally July, and the coldest January. The average number of days per year with maximum temperatures of 95°F or above was 11. The frost free growing season approximates 195 days. Killing frosts have occurred as late as May 11 and as early as October 2. Annual precipitation was approximately 48 inches. Normally more than 17 inches of rain falls during June, July, and August, but its distribution is frequently sporatic. The largest rainfall during 1 day was 6.4 inches, during 1 month, 15.6 inches. The mean annual snowfall is 8 inches, however as much as 22½ inches have been recorded.

2. SOME NEW CULTURAL TECHNIQUES WITH STRAWBERRIES IN EASTERN VIRGINIA.

M. M. Parker; *Virginia Truck Experiment Station.*

Current cultural experiments at Norfolk deal primarily with the performance of transplants set in the field at times other than the customary commercial planting time in early spring. Concurrently the experiments deal with systems of production and dates of planting.

Results: 1. Satisfactory yields of extra good quality fruit resulted the next spring following setting out one-year-old Pocahontas plants in hills in early November. 2. Similar quality fruit with perhaps better yields were obtained from stored plants set in hills in mid-August. 3 Poor results followed the use of two-year old plants dug and set after they had produced a crop of fruit.

3. THE DEVELOPMENT OF F_1 SPINACH HYBRIDS ADAPTED TO EASTERN VIRGINIA.

E. A. Borchers; *Virginia Truck Experiment Station.*

Field tests of numerous experimental F_1 spinach hybrids have shown that many hybrid combinations produce an appreciably larger yield than the standard commercial varieties. While most of the hybrids which exhibit the greatest vigor also possess undesirable horticultural characteristics, limited tests have indicated the possibility of obtaining hybrids with increased yielding ability and disease resistance which will be horticulturally acceptable in Tidewater Virginia. By means of controlled pollination procedures in the field and greenhouse, inbred lines and experimental hybrids are being developed and evaluated at the Virginia Truck Experiment Station with the goal of developing superior spinach hybrids for Eastern Virginia.

4. SOME NEW ASPECTS OF POTATO INSECT INVESTIGATIONS IN SOUTHEASTERN VIRGINIA.

R. N. Hofmaster; *Virginia Truck Experiment Station.*

Soil treatments with aldrin or heptachlor at 2.5 pounds actual/A. or dieldrin at 1.5 pounds actual/A. showed reductions of 92, 94, and 87 percent, respectively, in flea bettle damage to Irish potato foliage after three seasons. Soil treatments with these insecticides were effective against the Colorado potato bettle only during the first season. Irish potato varietal studies as related to the intensity of damage by flea bettles, wire worms, leaf hoppers, and associated pests have been conducted since 1953. These studies demonstrate a definite correlation between variety, leaf hopper control and tuberworm damage to tubers in the soil.

5. ENGINEERING USE OF PEDOLOGICAL SOILS INFORMATION.

Arnold C. Orvedal; *Soil Scientist, Soil Conservation Service, USDA, Beltsville, Md.*

Although both soil science and soil engineering deal with soils, these disciplines have developed rather independently. As a result, we today have two fundamentally different concepts of soil, two kinds of soil classification systems, and two sets of terminology. We therefore have obvious difficulties in communication. At the same time soil scientists have much to contribute and engineers have much to gain from pedological soils information. Widespread improvement is now taking place in mutual appreciation, understanding, and cooperation between engineers and soil scientists. As a result, pedological information, especially soil surveys, is being used more and more for engineering purposes, but the full potential is not yet generally realized.

6. RATES AND TYPES OF GROUND LIMESTONE FOR ALFALFA.

George D. Jones and W. W. Moschler; *Virginia Agricultural Experiment Station.*

Low rates of lime on Tatum silt loam is resulting in low yields and early death of alfalfa stands. Dolomitic limestone is slightly but consistently outyielding the calcic limestone, notwithstanding the fact that the calcic stone is more chemically reactive as evidenced by soil tests at intervals following application. No alfalfa lived where lime was not applied, 250 pounds per acre was only sufficient to start it, 500 pounds lasted about one year, and 1000 pounds lasted about two years. There is evidenced that 2000 pounds will last about three years, and higher rates in proportion.

7. 2-3-5 TRIPHENYL TETRAZOLIUM CHLORIDE AS A QUICK TEST IN DETERMINING VIABILITY OF SMALL GRAIN SEEDS.

T. G. Copeland, Jr., and C. F. Bruce; *Division of Plant Industry Virginia Department of Agriculture*

Standard germination tests evaluate the performance of seed under artificial and optimum conditions. Due to the time factor for such tests, the Department has been searching for a quick seed viability test. We believe that the chemical 2-3-5 Triphenyl Tetrazolium Choloride offers a partial answer. When normal respiration processes take place in the living cells of the seed embryo, free hydrogen is released which will reduce tetrazolium Chloride offers a partial answer. When normal respiration processes take place in the living cells of the seed embryo, free hydrogen is released which will reduce tetrazolium chloride to a reddish compound (2-3-5 triphenyl formazan). Dead cells do not release hydrogen and from the red color. This enables the analyst to observe the viability of the individual parts of the embryo.

8. TRENDS IN FERTILIZER TECHNOLOGY.

W. L. Hill; *Fertilizer Materials Section,*
Soil and Water Conservation Research Division, USDA, Beltsville, Md.

Fertilizer manufacture involves large tonnages of materials. The domestic industry moved nearly 23 million tons to farms in the year ended June 30, 1957. The techniques of production, one of three interlocking agricultural technologies—fertilizer making, soil management and crop production, is concerned with winning suitably-reactive, nutrient-bearing compounds in uniform, stable and free-flowing assemblages designed to meet crop needs in particular market areas. Noteworthy changes in modes of operation are witnessed by continuous increase in purity of products, by methods for closer characterization of raw materials and products, by integration of manufacturing sequences, and by expansion of production into new market areas with facilities that employ advanced techniques.

9. WOODCHUCKS: A MAJOR AGRICULTURAL PEST IN VIRGINIA.

John C. Jones; *U. S. Department of the Interior.*

Woodchucks, or groundhogs are causing serious losses to nearly all types of agriculture in most sections of Virginia. Their numbers appear to have increased markedly in the past 10 years and the range has spread, particularly in eastern counties. Forage crops, especially alfalfa and soybeans, and vegetable crops are major sources of food. Burrows are damaging to fields and pastures, causing erosion, frequently damaging machinery and occasionally breaking legs of stock. Orchard and nursery stock is commonly clawed, chewed and damaged. Control is relatively simple, by gas, in spring of the year when burrows are first opened.

10. NUTRITIONAL STATUS OF RURAL HAITIANS.

K. W. King and G. L. Brinkman; *Virginia Polytechnic Institute.*

During the summer of 1958, the nutritional status of rural Haitians was evaluated by a 20-member team of Haitians and Americans. Data of the following types were obtained: general indices of the economy, social structure and health; actual and potential agricultural production; food consumption through interview; medical examinations of 3,000 people aged 5 to 75 years old for clinical evidences of malnutrition, and biochemical analyses of blood and urine specimens from 500 of these patients for specific nurtients and excretion products. The general nutritional status of the population was summarized. Interactions between the nutritional problems and economic relapse, primitive agri-business, public health, political instability, and social custom were discussed.

11. PURIFICATION OF THE GROWTH FACTOR IN MEAT MEAL.

P. Lepore and C. J. Ackerman; *Virginia Polytechnic Institute.*

When rats are fed sulfaguanidine in an otherwise complete diet, growth ceases after the 4th week. When meat meal or certain animal tissues are included in such diets, growth is almost normal. Purification of the growth promoting activity consists of acid hydrolysis followed by acetone extraction of the acid insoluble residue. The addition of water to the acetone extract results in the separation of an active parcipitate. Addition of Ba $(OH)_2$ to the filtrate yields a precipitate and a filtrate which are both active in promoting the growth of sulfaguanidine-fed rats.

12. THE INFLUENCE OF DOMINANCE RANK OF SEXUAL ACTIVITY OF CHICKENS.

P. B. Siegal; *Virginia Agricultural Experiment Station.*

An experiment was conducted to determine the influence of peck rights on the sexual activity of White Rock cockerels in multiple male-matings. Results indicate differences between male groups and between males within groups for sexual activity as measured by number of courts, mounts, treads and completed matings. Interferences for mounts and treads were not uni-directional (interference by a dominant male to a subordinate one) whereas interferences for courts were, indicating a loss of recognition during the mating act. Also, males which were highest in the social heirarchy did not necessarily have the greatest drive.

13. THE EFFECTS OF EQUINE GONADOTROPHINS ON VARIOUS REPRODUCTIVE PHENOMENA OF THE EWE.

C. H. Kiracofe and J. W. Gossett; *Virginia Agricultural Experiment Station.*

Pregnant Mare Serum was used in this project to study its use as a factor to produce superovulation and thereby produce higher lambing rates among ewes. It was found that ovulation rates, number of live embryos at 40 days, and number of lambs born were increased in the injected ewes. Conception rates, estrus cycles and vitality of the lambs were not affected by the hormone treatment. Although P.M.S. can be used to increase lambing percentages, the increase came not from an increased frequency of thinning, but from the number of triplets and quadruplets produced.

14. THE EFFECT OF CERTAIN FEED ADDITIVES AND FEED PREPARATIONS FOR FATTENING FEEDER LAMBS.

H. A. Hopkins, J. P. Fontenot, W. M. Mestanza and J. S. Copenhaver; *Virginia Agricultural Experiment Station*

The effect of feeding 2 mg. stilbestrol per head daily and 10 mg. aureo-

mycin (chloretetracycline) per pound of feed, alone and in combination, and of grinding and pelleting hay, pelleting corn and pelleting the entire ration was studied in 90 fattening feeder lambs. There was a trend for aureomycin feeding to depress rate and efficiency of gain and for stilbestrol feeding to increase these. Grinding the hay increased feed intake, and rate and efficiency of gain. Pelleting increased feed efficiency. A much higher incidence of rumen parakeratosis, a pathological condition, was observed in lambs fed pellets than in those not receiving pellets.

15. CELL DIVISION IN ACTIVELY GROWING FOLLICLES AND THE CHROMATIN REACTION IN THE SKIN OF SHEEP.

Lubow A. Margolena; *Sheep, Goat and Fur Animal Research Branch, A.R.S., Beltsville, Maryland*

Mitotic counts in matrices of actively growing wool follicles and observations on the chromatin reaction in skins and follicles of merino and Hampshire sheep were carried out throughout the seasons at Beltsville, Maryland. In both breeds, mitoses averaged about 70% higher in early and mid summer than in the winter months. Spring and summer specimen exhibited pronounced chromatin reactions (Feulgen), while winter biopsies proved to be practically achromatic. Hence, provided nutrition is adequate, the rate of growth of the wool fiber is expected to depend on the season of the year.

16. USE OF ELECTRONIC DATA COMPUTING METHODS TO ANALYZE THE BASIC SURVEY OF VIRGINIA DAIRYING.

Robert F. Hutcheson; *Virginia Department of Agriculture.*

A basic survey of Virginia dairying is being jointly conducted by the Virginia Department of Agriculture and the Virginia Agriculture Extension Service. Questionnaires for the studies are pre-coded for rapid analysis by electronic data computing methods. As a result, a very detailed picture of the size, volume, methods, equipment and economic and social factors having to do with Grade A dairying has developed. Also, the first thorough picture of the markets, market organization, and farm to market patterns has been portrayed. Information is available on a county, district and state wide basis as well as by markets and marketing organizations.

17. THE ECONOMICS OF FEEDING GRAIN TO MILKING COWS ON PASTURE.

W. A. Hardison and G. C. Graf; *Virginia Agricultural Experiment Station.*

Two grazing trials were conducted to study the effect of supplementary grain feeding of cows on pasture. In both trials the cows grazed, rotationally, on orchard grass ladino clover mixture of high quality. Trial 1 ground shelled corn and a simple 16% TP supplement were compared with

no supplement. A mixture of corn and oats, a simple 16% TP supplement, and no supplement were compared in Trial 2. Only in the instance when a mixture of corn and oats was fed in Trial 2 did supplementary feeding result in enough extra milk produced to pay for the supplement.

18. PROGRESS REPORT ON RESEARCH ON DWARFISM IN BEEF CATTLE.

T. J. Marlowe, D. F. Watson, and N. O. Price;
Virginia Agricultural Experiment Station.

Studies on dwarfism at V.P.I. have been pointed toward the pathology of the dwarf. Complete necropsies of 23 dwarf and 10 normal calves revealed several gross abnormalties; however, histological examination failed to reveal any striking differences. Dwarf x dwarf matings always produce dwarfs. Bioassays for thyrotropic, ACTH and gonadotropic hormone revealed no significant differences between dwarf and normal calves. Blood analysis for PBI, glucose, calcium, phosphorus, magnesium and phosphate activity failed to yield significant differences. Present research is directed toward morphological site of gene expression, period it operates, and mode of action by studying known genotypes during early fetal development.

19. PRELIMINARY INVESTIGATION OF THE FERMENTATION OF UNIFORMLY LABELLED C^{14}-GLUCOSE BY RUMEN MICROORGANISMS.

J. H. Newman and W. E. C. Moore;
Virginia Agricultural Experiment Station.

Samples of rumen fluid were incubated with uniformly labelled glucose for 1½ hours in a closed system. Distribution of activity in both unfermented control samples and fermented samples was determined among protein and particulate material, ether extractable substances, amino acids, and peptides, sugars and other neutral molecules, carbon dioxide, and methane. Samples counted as barium carbonate followed wet oxidation indicated 80 to 85% C^{14} recovery, with additional losses in some individual fractions. Data indicate differences between fermentation activity in samples from two animals. Major C^{14} products include protein and cells, ether extractables, and carbon dioxide (29, 10.5, and 15.6%, animal 1; 14.5, 23.5, and 14.3%, animal2).

20. THE EFFECT OF IMPLANTING DIFFERENT LEVELS OF STILBESTROL IN GRAZING BEEF STEERS.

J. P. Fontenot, R. F. Kelly and J. A. Gaines;
Virginia Agricultural Experiment Station.

At the beginning of each of two grazing seasons, 5 groups of 8 steers each were implanted, in the ear, with the following levels of stilbestrol: 0,

12 mg., 24 mg., 36 mg., and 48 mg. A 12 mg. implant increased rate of gain 20% ($P<.01$). Increasing the level of stilbestrol above 12 mg. did not further affect gain significantly. When 12 mg. of the drug were used carcass grade was not affected. When the level was increased to 36 and 48 mg. a decrease in grade resulted ($P<.05$). When the level of stilbestrol used was 24 mg. or higher chemical composition of the meat was affected.

21. EFFECTS OF SELECTED PHYSICAL AND ECONOMIC VARIABLES ON PRICES OF CALVES IN VIRGINIA FEEDER CALF SALES.

K. C. Williamson, R. C. Carter, G. W. Litton, J. D. Johnson, and J. A. Gaines;
Virginia Polytechnic Institute

Records of 21 Virginia Feeder Calf Sales held annually from 1951 through 1956, were studied to determine the effect of certain selected variables on the average prices received for calves. Effects of the variables studied were estimated by the least squares method with separate analysis for steer and heifer calves. The breed, weight, and grade had rather large statistically significant effects on the price of both steer and heifer calves. The price of steer calves was also significantly effected by the size of the sale and size of the sale lot but not the heifer calves.

Business Meeting

Officers elected for next year: Chairman, Maurice B. Rowe; Vice-Chairman, W. H. Brittingham; Secretary, Carl W. Allen; Editor, (3 Year Term), P. B. Siegel.

In other business, ways and means of getting broader support to further the usefulness of the section were examined .The possibility of joint sessions, sub-sections on narrower areas of work, e.g., crops and soils, feeds and nutrition, and obtaining the whole-hearted backing of the agricultural leaders in the State were discussed. These are to be considered in building the program for the 1960 meeting.

ASTRONOMY, MATHEMATICS, AND PHYSICS

1. THE EQUILIBRIUM ULTRACENTRIFUGE.

Charles E. Williams, Richard D. Boyle, J. W. Beams;
University of Virginia

A description of the magnetically supported ultracentrifuge is presented. It can be applied to the problem of molecular weight determination by the sedimentation equilibrium method. The equipment used consists of a 29 pound steer rotor, spinning at speeds of 400 r.p.s. in a vacuum chamber. A dilute solution of the sample being studied is placed in a sector shaped cell contained in the rotor. The rotor is accelerated by means of an air turbine and allowed to coast until the rate of sedimentation and the rate of diffusion of molecules balance each other, thus establishing a condition for equilibrium. Measurements of concentration distribution within the cell are made from a changing interference pattern of a Jamin type inteferometer.

2. FAST PHOTO-NEUTRONS FROM TANTALUM AND GOLD.

L. B. Aull and G. C. Reinhardt;
University of Virginia

The yield and angular distribution of photo-neutrons from tantalum and gold with energies above the Si^{28} (n,p) threshold have been measured with bremsstrahlung from the University of Virginia synchrotron. Cylindrical silicon detectors were mounted coaxially with the sample being irradiated, and the resultant Al^{28} activity determined. The integrated cross section for both elements was about 400 mb-Mev. to 30 Mev., and 800 mb-Mev. to 64 Mev. The angular distribution for both elements fitted approximately a curve $(a + b \sin^2 \theta + c \cos \theta \sin^2 \theta + d \cos \theta)$.

3. PHOTO-PROTON YIELDS FROM LIGHT ELEMENTS.

D. C. Worth and G. R. Haste;
University of Virginia

Using high energy X-rays from the University of Virginia synchrotron, various investigators are studying "photonuclear" re-actions (in which X-ray energy absorbed by a target nucleus results in emission of one or more nucleons). Photoneutrons are generally more abundant than photoprotons from medium and heavy elements, but investigation of how either type of emission varies with X-ray energy can give important information about nuclear processes involved in photo-absorption and emission. This paper outlined experiments for the direct counting of photoprotons from several

light elements (especially carbon and lithium) by means of thin scintillation crystals, and presented some preliminary results.

4. ANGULAR DISTRIBUTIONS OF 15 MEV NEUTRONS ELASTICALLY SCATTERED BY LIGHT ELEMENTS.

B. C. Groseclose, R. F. Stetson, and W. W. Walker;
University of Virginia

Angular distributions of 15 MEV neutrons elastically scattered by O, Mg, and Al have been measured up to 130°. An angular distribution was also done for Mg at 14 Mev to investigate possible anomalous energy variations in the differential cross section. A ZrT target was used to produce neutrons by means of the $T(d,n)He^4$ re-action. The neutron beam was electronically colliminated by time-of-flight techniques and the data recorded on a 20-channel analyzer, gated by the $n-\alpha$ coincidences. The data are compared with the theoretical optical model calculations of Bjorklund and Fernbach. The agreement with theory is very good. No anomalous changes for Mg were found.

5. DEMONSTRATIONS OF PARIATY CONSERVATION.

Frank L. Hereford and John S. Plaskett;
University of Virginia

Simple demonstrations of parity conservation in electromagnetic interactions were given, which are suitable for elementary physics courses.

6. A PRECISION 0-20 AMPERE MAGNET CURRENT CONTROL.

M. W. Chramiec and C. D. Bond;
Virginia Polytechnic Institute

The use of field regulated generators as stable current sources for low impedance analyzing magnets is now rather extensive and both design considerations and detailed circuits are well treated in the literature. The advantages of the system described here allows one to use commercially available units together with a relatively simple feed-back circuit to achieve a stability of $+5$ parts in 10^5 at full output. The current level can be varied, set and measured to <0.01 amperes with a single control. Regulation is automatically monitered and maintained indefinitely.

7. A WATER-MODERATED NATURAL URANIUM SUB-CRITICAL REACTOR.

T. H. Row and Andrew Robeson;
Virginia Polytechnic Institute

A reactor system of this type was added to the Reactor Laboratory

facilities because of its extensive use in power reactors. The advantages of the system are numerous and include variation of moderator temperature, addition of moderator poison, and variation of lattice geometry and orientation. The disadvantages associated are the inability to measure critical size and the corrosion problems arising from the use of tap water. The rectangular steel tank used for the containment vessel has positioning apparatus for the Plexiglass tube sheets. Either a horizontal or vertical lattice of the aluminum fuel elements can be arranged. The experimental work includes determining the relation of material buckling to moderator temperature, moderator poison, and moderator to fuel volume ratios. A calculation of the multiplication factor for the system was made and found to be 0.5325.

8. OBSERVATION OF THE DECAY OF ADSORBED BARIUM – 133 IN THE FIELD EMISSION MICROSCOPE.

William C. Saunder; *Virginia Military Institute*

An experiment is proposed to determine if the characteristic granulation of the field emission image of small amounts of barium adsorbed on tungsten arises from individual barium atoms or circular clusters of barium atoms. Barium – 133, which decays by electron capture to become stable Cesium – 133, will be employed as the adsorbate. It is shown theoretically that if the granulations are blurred images of individual atoms, as an atom of Barium – 133 decays, the corresponding image of the atom will be intensified by a factor of two or three. However, of the granulations are due to circular clusters 40 to 200 angstrom units in diameter, the image intensification will amount to less than 10% as the Barium – 133 decays. A brief theoretical investigation indicates that the recoil of the adsorbed atom during decay will not affect the validity of the experiment.

9. DIVISIBILITY TESTING.

Herta T. Freitag; *Hollins College*
Arthur H. Freitag; *Jefferson High School*

This procedure establishes the divisibility of any natural number N by any other natural number p whenever N – O(p). The quotent N may also be determined by this device. If N – r (p), r O, then r is obtainable (to be presented in a later paper.) This method may be of some interest because (a) of the number properties involved; (b) of its simplicity; (c) a quotient may be found without the operation of division (or of successive subtractions of the divisor from the dividend.)

10. SOME ASPECTS OF TERMINAL BALLISTICS.

Robert L. Kernell; *College of William and Mary*

In testing a formula for the penetration of projectiles in a target of brittle spheres, it became necessary to determine the size distribution of fragments created by comminution. After passing the fragments through graded sieves, the diameters of the smaller fragments were measured with a microscope. These results were normalized and combined with the average diameters of the larger fragments. A plot of dN/ds against s (where N is the number of fragments and s is the diameter) was used to numerically integrate $\int s^2 \frac{dN}{ds}\, ds$ and $\int s^3 \frac{dN}{ds}\, ds$. This permitted evaluation of the mean fragment diameter from which the surface area created by comminution could be calculated.

BUSINESS MEETING.

The Astronomy, Mathematics, Physics Section business meeting was held at 11:45 A.M. Friday, May 8, 1959 in the Large Auditorium of the Physics Building of the University of Virginia. The following officers were elected by unanimous vote: *Chairman*, Robert C. Yates (William and Mary); *Secretary*, Andrew Robeson (Virginia Polytechnic Institute). There was discussion of the question concerning the formation of a separate section of Mathematics which was tabled. Miss Isabel Boggs reported progress on her work pertaining to the History of Science in Virginia. I. G. Foster was commended for faithfulness as section editor.

11. CURVATURES OF $r^n = \cos n\theta$.

Robert C. Yates; *College of William and Mary*.

The Lemniscate, the Hyperbola, the Cardioid, and the Parabola are the curves of $r^n = \cos n\theta$ for $n = 2, -2, \frac{1}{2}, -\frac{1}{2}$, respectively. Assuming constructibility of multisection of angles then tangents, normals, and centers of curvature of these familiar curves have surprisingly simple constructions. Techniques are based upon the expression $\tan \psi = r/r'$ and $R = ds/d\alpha$ where α is an inclination of the tangent.

12. PROBABILITY FOR HIGH SCHOOL STUDENTS.

Beatrice A. Harrington; *Maggie L. Walker High School*

The members of our mathematics club made a study of the theory of probability, first restricting our mathematical models to sample spaces having a finite number of outcomes. We then performed an experiment resulting in an infinite number of outcomes. Three players tossed a die

in turn with the winner being determined by the appearance of a "1" or a "6". We played the game 700 times and compared the predicted frequency of occurency of certain events according to probability theory, with our observed results. We were gratified with our findings.

13. A LABORATORY FOR LIBERAL ARTS PHYSICS.

John Lacy McKnight; *College of William and Mary*

In conjunction with a course in physics for liberal arts students, we have attempted to conduct a laboratory which would give the student an opportunity to repeat some historically important experiments under conditions like those under which the original experiments were conducted. In these, the student is referred to the original description of the experiment in his text and/or primary sources. We are attempting, as well, to show the logical aspects of physics and to demonstrate some of the phenomena omitted in our lecture outline. In these experiments equipment is kept as primitive as possible and only one principle is introduced at a time.

14. HISTORICAL AND PHILOSOPHICAL EXPERIMENTS IN ELEMENTARY PHYSICS.

Richard H. Prosl; *College of William and Mary*

15. THE JUNIOR INSTRUCTORSHIP PROGRAM AT WILLIAM AND MARY.

R. C. Yates, Garret Etgen, and Richard H. Prosl;
College of William and Mary

The program of student-teaching at William and Mary was discussed by two of the student participants and the directing professor. Each student-teacher performed all duties of instruction of one section of freshman mathematics throughout the year. The supervising professor attended each class meeting for observation, and held conferences with the student-teachers before and after each class. All tests, examinations, and grades were supervised with the professor as final responsibility. Student teachers were paid a nominal fee for their work, but were not awarded academic credit. Citations were installed on their academic transcripts.

16. EXPERIMENTS FOR ADVANCED UNDERGRADUATES.

W. D. Whitehead; *University of Virginia*

A series of experiments have been developed for an Honors laboratory section in elementary physics, one of these is the measurement of the range energy relationship of a metal washer on a table top. The experiment is divided into three parts, the energy calibration of the "ac-

celerator" which is a heavy pendulum that strikes the washer, the measurement of the range energy relationship on a table top, and the analysis of energy and momentum relationships for collisions of washers on the table top. The experiment is very instructive both in classical mechanics, and in giving the student some idea of the methods used in nuclear physics experiments.

17. AN APPARATUS FOR THE MEASUREMENT OF THE RANGE OF AN ALPHA PARTICLE IN AIR.

James Little; *College of William and Mary*

Alpha particles of a given energy have a well defined range in air. This range and the specific ionization in the path can be measured with this instrument. The ions formed between a charge grid and a collector plate are measured with a current shunt on an electrometer. A Bragg curve is obtained by plotting position *vs.* current. When used with Polonium 210 the range was found to be slightly higher than literature value.

18. AN INTERMEDIATE LABORATORY EXPERIMENT ON RUTHERFORD SCATTERING OF ALPHA PARTICLES.

E. T. Gerry; *College of William and Mary*

Scattering experiments are of fundamental importance in nuclear physics. Rutherford scattering is of historical importance since the results of these early scattering experiments brought about the acceptance of the nuclear model of the atom. Such experiments also give information as the size of the nucleus. It was desired to develop an experiment on Rutherford scattering for use in an intermediate level nuclear physics course. Apparatus using a scintillation screen and photomultiplier tube for measurement of count rate versus scattering angle is described. Typical results are presented.

19. AN ANALOG COMPUTER USED IN REACTOR SIMULATION.

Wm. S. Baber and Andrew Robeson; *Virginia Polytechnic Institute*

A compact analog computer developed by the Heath Company has been built and used to extend the range of operation of the Virginia Polytechnic Institute Nuclear Reactor Simulator. A variable temperature coefficient is simulated on the computer by utilizing a signal from the reactor simulator, performing the necessary operations and then feeding the resultant signal back to a bus on the reactor simulator. Some techniques of reactor simulation were discussed.

20. SIMULTANEOUS PHOTO-ELECTRIC EFFECT OF TWO ELECTRONS.

Frederic R. Crownfield; *College of William and Mary*

Since it is quantum mechanically impossible to distinguish between two electrons, it is not surprising that there should be processes in which two or more electrons in the same atom undergo transitions simultaneously. The simplest approximate wave functions for helium, for example, give a null result for the probability of such a transition. Calculations with somewhat improved wave functions, however, do not give such a result. The calculation of the transition probabilities for simultaneous transitions were outlined and possible experimental methods for verifying the theory were discussed.

21. UNFAMILIAR FACTS CONCERNING THERMOELECTRICITY.

L. G. Hoxton; *University of Virginia*

The recent revival of research in thermoelectricity, occasioned initially by studies of the properties of semiconductors, is not unfamiliar to many. Yet it is assumed that some details of developments in the production of power, in refrigeration and in heating have not had time to lose their interest. In addition, a well-nigh universal misapprehension concerning the original discovery of the (basic) "Seebeck effect" were discussed.

22. ELECTRICAL CONDUCTION IN THIN MAGNETIC FILMS,

A. D. Campbell, J. F. Garren, Jr., A. C. Hudgins, Jr. and B. W. Sloope; *University of Richmond*

Some aspects of the theory of electrical conductivity of thin films of metal are discussed. These are then applied to the case of thin magnetic films of Ni and Ni-Fe. Measurements of the electrical resistance were made on several films of different thicknesses with current applied in the direction of and perpendicular to the direction of the magnetization. The results of the measurements were discussed and compared with available theory.

23. SURFACE DEFORMATIONS ON SINGLE CRYSTALS OF COPPER AT VARIOUS TEMPERATURES.

John M. Bailey; *University of Virginia*

Surface deformation, which is important in the wear of metals as well as in many other metal surface phenomena, was studied by indenting various flat faces which had been carefully prepared on a single crystal of copper, and by scratching these faces at various directions. Styli with a wide range of radii were used, and normal and frictional

force on the stylus was measured. Experiments were conducted in air or in hydrogen at temperatures up to 800°C. The deformed regions were examined by optical and electron microscopes. Dislocation arrangements were studied by means of etch pits. The depth of plastic deformation was measured by means of electrolytic sectioning. Surfaces deformed at intermediate temperatures (300-500°C, for a stylus with 794 micron radius, and 250°C to at least 800°C, for a stylus with 63 micron radius) recrystallized spontaneously. Deformation at higher temperature resulted in polygonization.

24. MOTIONS AND ABSOLUTE MAGNITUDES OF MIRA TYPE STARS.

H. L. Alden, V. Osvalds; *McCormick Observatory*
A Marguerite Risley; *Randolph-Macon Woman's College*

25. OSCILLATION THEOREMS FOR DIFFERENCE EQUATIONS.

John S. Plaskett; *University of Virginia*

Theorems analogus to those proved by Sturm for self adjoint differential equations are shown to hold for difference equations.

26. THE ELASTIC AND PLASTIC DEFORMATION OF VERY SMALL CADMIUM SINGLE CRYSTALS.

Thomas Ratchford; *University of Virginia*

Small cadmium single crystals, grown by deposition of the metal from the vapor phase in helium, were tested under applied pure tensions. These crystals had the shape of "ribbons," oriented such that basal slip could not occur. These ribbons had high yield stresses, and deformed by slip and twinning. The slip systems were the (1212)/[1213] (pyramidal) system, and the (0110)/[2110] (prismatic) system. Twinning seemed to be nucleated by the prismatic slip, the system by which fracture always occurred. Dislocation models are being developed to explain these phenomena.

27. CONDUCTIVITY OF METAL WHISKERS AT LOW TEMPERATURES.[1]

E. P. Stillwell; *University of Virginia*

The electrical conductivity of copper whiskers grown from the hydrogen reduction of copper bromide and copper iodide has been studied as a function temperature from 273 degrees K. to 4.2 degrees K. Deviation from the bulk values are interpreted in terms of a contribution to the resistivity due to the inclusion of impurities in the crystal lattice plus a contribution to the low temperature resistivity due to the surface.

[1] This work supported by the Office of Naval Research.

28. PIEZORESISTANCE EFFECT AT VERY HIGH ELASTIC STRAINS IN METALLIC WHISKERS.[2]

Herman H. Hobbs; *University of Virginia*

The effect of large elastic extensions on the resistivity of whiskers of Cu, Fe, Cd, and Zn has been studied. The maximum strains obtained were of the order of 0.02 thus extending considerably the range of previous observations. The strain resistivity tensor $\left(\frac{\Delta P}{P}\right)_{ij} = K_{ijkl}\,\xi_{kl}$ for Cu whiskers grown from $CuBr_2$ has been determined. Results from copper whiskers grown from CuI and $CuBr_2$ indicate that inclusions of small amounts of Iodine or Bromine may have a strong effect on the strain-resistivity of copper. The strain-resistance curve for Zinc whiskers (oriented 30° from the C axis) is quite linear while the curve for Zinc ribons (oriented parallel to the close packed plane is strongly non linear.

29. POSITRON LIFETIMES IN WATER AND ICE.

W. W. Walker and W. S. Walker; *University of Virginia*

Positron lifetimes in water and ice have been measured as a function of temperature with particular emphasis on the water-ice phase change. Values of the mean life of the long-lived component (τ_2) for temperatures between -165° C and + 65°C will be given. A change in τ_2 at the phase transition has been observed. For water τ_2 has the approximately constant value of 1.5 ± 0.2 millimicroseconds and for ice τ_2 equals 0.8 ± 0.2 millimicroseconds. The intensity of the τ_2 component (I_2) has been observed to increase for the water-ice transition.

30. POSSIBLE EFFECTS OF FORCE FIELDS.

Leon Sembach; *University of Virginia*

We inquire into the possible effects of force fields upon radioactive decay rates. The apparatus used to measure decay rate of Cu^{64} when subjected to 5.75×10^5 g's produced by an ultracentifuge is described.

31. MECHANICAL PROPERTIES OF THIN POLYCRYSTALLINE METAL FILMS.

H. H. Pattillo; *University of Virginia*

The mechanical properties of thin evaporated polycrystalline films of gold and silver have been studied as a function of their thickness. Films less than approximately 1.5×10^{-5} cm in thickness show a marked increase in tensile strength, while films thicker than this have a tensile strength

[2] This work supported by the Office of Naval Research.

approximately equal to that of the bulk material. These values are in rough agreement with measurements by the centrifugal method on electrodeposited films. The increased tensile strength is believed due to actions of dislocations in the metals. Young's Modulus measurements in the elastic region give results apparently too high, and an explanation is being sought.

32. ELASTIC SCATTERING OF 2- TO 4-MEV POLARIZED NEUTRONS.

W. P. Bucher, W. B. Beverly, and G. C. Cobb; *University of Virginia*

The polarization of 2-Mev to 4-Mev neutrons elastically scattered by deuterium and carbon has been observed. The polarization produced in neutron-deuterium scattering was found to be negligible in agreement with theoretical estimates. The neutron-carbon polarization had the same energy dependence as predicted by phase shifts determined from differential cross section measurements of other workers. However, the magnitude of the polarization was larger.

33. RECENT HIGH PRESSURE INVESTIGATIONS OF SOLIDIFIED GASES AT LOW TEMPERATURE.[1]

John W. Stewart and Robert F. Patterson; *University of Virginia*

The piston displacement technique has been applied to a study of phase transitions and compressibilities of solid CH_4, CD_4, and O_2 over the pressure range o — 19,000 kg/cm^2 and the temperature range 4°K — 120°K. The volume of the sample is observed as a function of pressure. Phase transitions appear as discontinuities in V (first order), or in dV/dP (second order). Solid CH_4 and CD_4 each show three phases and one triple point. The transitions appear to be second order with rather large "regions of indifference." There are considerable differences between the isotopes CH_4 and CD_4. At atmospheric pressure CH shows one transition at 20.5°K, while CD, has two, 22.1° and 27.2°. The two first order transitions in solid oxygen have been traced to high pressure. The upper transition has a very large volume discontinuity. Some difficulty was experienced from ignition of the steel pressure chambers by the solid oxygen under high pressure.

34. THE SURFACE STRUCTURE OF GROWING CRYSTALS.

N. Cabrera; *University of Virginia*

[1]Supported by Office of Ordnance Research, U. S. Army.

BACTERIOLOGY

1. THE ENZYMATIC FORMATION OF D-ARABINOSE-5-PHOSPHATE

Wesley A. Volk; *University of Virginia*

D-Arabinose-5-phosphate has been isolated from mixtures of phosphorylated pentoses resulting from phosphorylation of L-arabinose or D-ribulose and ATP by crude extracts of *Propioni-bacterium pentosaceum*. An enzyme has been partially purified from these extracts which isomerizes both enzymatically formed and chemically synthesized D-arabinose-5-phosphate to a ketopentose phosphate presumably D-ribulose-5-phosphate.

The mechanism of formation of D-arabinose-5-phosphate will be discussed as well as some of the properties of the isomerase acting on D-arabinose-5-phosphate.

2. A COMPARATIVE STUDY OF MEDIA FOR THE DETECTION OF ENTEROCOCCI IN WATER.

R. Travis Hill; *State Department of Health Laboratory*

The fecal streptococci may prove of value as supplementary indicators of water pollution. Methods for their determination have not to date been included in Standard Method procedures, hence their evaluation by a committee. Two broth media for the tube dilution and one membrane filter medium were selected for comparative study in 8 different laboratories throughout the United States. Coliform densities were first obtained by the standard tube most probable number dilution method, in order that a relationship of the ratio of coliform to enterococci could be relatively determined.

3. SERUM LYSOZYME LEVELS IN RABBITS UNDERGOING A GENERALIZED GRANULOMATOUS REACTION.

Quentin N. Myrvik and Eva Soto Leake;
Department of Microbiology School of Medicine, University of Virginia

Rabbits vaccinated with BCG were given an intravenous infection of BCG four weeks after vaccination. A marked granulomatour reaction is elicited in the reticuloendothelial system. Soon after the introvenous infection of BCG the level of lysozyme increases markedly and after several days gradually returns to normal. The possible source of lysozyme will be discussed.

4. REDUCTION OF POTASSIUM TELLURITE BY *Streptococcus bovis*.

Margaret Carlson and P. Arne Hansen;

Department of Microbiology, University of Maryland

Reduction of potassium tellurite, useful as a tool for differentiation of fecal streptococci, was examined as a possible differential characteristic of *Streptococcus bovis*, a species which is not an "enterococcus." Test methods included incorporation of the potassium salt (concentration 0.04%) into both fluid and solid medium. Qualitative and quantitative determinations based upon growth in fluid medium appeared equivocal. Results obtained in solid medium were clear-cut and reproducible. All isolates were shown to be capable of reduction of potassium tellurite if tested under microaerophilic conditions.

5. OBSERVATIONS ON THE EFFECT OF CARBON DIOXIDE ON THE GROWTH OF *Entamoeba histolytica*.

E. Clifford Nelson and Muriel M. Jones;

Department of Microbiology, Medical College of Virginia

A simple monophasic medium was found to support the growth of *Entamoeba histolytica* if the medium was saturated with and held in an atmosphere of carbon dioxide. A newly isolated strain was found to be more dependent on carbon dioxide addition than a strain grown for many years. The observations suggest that *E. histolytica* may have a carbon dioxide requirement.

BIOLOGY

1. EXPERIMENTAL EVOKATION OF DIFFERENTATION OF CHICK MELANOCYTES.

William M. Reams, Jr. and Stuart E. Nichols, Jr.;
Medical College of Virginia

This report deals with the capacity of certain chemical agents to evoke the branching of previously unbranched melanocytes within the peritoneum of Black Langshan chick embryos. Employment of small quantities of citric acid or of a CO_2 atmosphere in tissue cultures containing embryonic peritoneum laden with spherical melanocytes resulted in the branching of these cells. Citric acid injected *in ovo* produced precocious branching of the pigment cells in the vicinity of major blood vessels and dense capillary beds within the peritoneum. And, in most instances, resulted in an absence or reduction in the number of pigment cells within the peritoneum. (Supported by NIH Grant No. C-3450).

2. SEROSAL MELANOCYTES IN THE PET MOUSE.

Stuart E. Nichols, Jr. and Willie M. Reams, Jr.;
Medical College of Virginia

Save for the report of Burns that the processus vaginalis of the opossum is pigmented, mammals have been considered to lack pigment cells in the serosa of the body cavities. Recently, however, pigment cells have been found distributed in the serosa of a strain of mice, termed PET, maintained in this laboratory. The evidence available indicates that the three major pigmented areas (pleura, diaphragm and peritoneum) have their own respective sites of initial entry of melanoblasts from the neural crest. Experimentally, it has been shown that a melanoblast in the course of its differentiation into a definitive melanocyte passes through an intermediate stage of either a branched melanoblast or an unbranched melanocyte. The possible role of a chemical "effector" of pigment cell shape and its species specificity are discussed. (Supported by a grant from the Cancer Division of NIH.)

3. TECHNIQUES WITH A MICRORESPIROMETER.

Jack D. Burke, *University of Richmond*

A volumetric microrespirometer and a simplified shaking device is described. This apparatus is suitable for oxygen consumption analysis using different animals. The apparatus is also adequate for Q_{O_2} experimental procedures as well as classroom demonstrations. Readings can

be made critically at the 0.01 ml. level of accuracy. Techniques and procedures for Qo_2 analyses are discussed in relation to data obtained using bullfrog tadpoles (*Rana catesbeiana*) and red-spotted newts (*Diemictylus viridescens*).

4. THE EFFECTS OF PROPYLTHIOURACIL OF GROSS WEIGHTS OF THYROID OVARIES, AND ADRENALS OF THE ALBINO RAT.

Iris B. Hadden and W. L. Mengebier; *Madison College*

A .05% propylthiouracil solution administered both orally and subcutaneuosly into the system of female Sherman albino rats produced the following organ weight increases: thyriod 170%, adrenals 30%, ovaries 165%. The total average body weight increase was 40%. Average daily body temperatures over experimental period were 1.18° lower than control animals, probably indicative of a lowered B.M.R. Weight increases of the adrenals and ovaries will be discussed relative to other publications.

5. TISSUE ERGOTHIONEINE.

Kamal Yackzan; *Florida State University* and *University of Richmond*

Ergothioneine's presence in animal tissues was first reported by Yackzan (M.S., 1951, Vanderbilt), using paper chromatography. The technique described by Lawson *et. al.* utilizes Hunter's diazo reaction and collodine-lutidine in the ration 3/2. A modification of this ratio plus the introduction of Baldridge and Lewis' solvent to the paper chromatograph's atmosphere increased specificity of the method. The interference of tyrosine and histidine was thus overcome. This technique represents a new approach in chromatography. Tissue extracts from the albino rat showed the presence of ergothioneine as follows: liver, 0.122 mg/gm; kidney, 0.083 mg/gm; heart, 0.03 mg/gm; spleen, 0.021 mg/gm.

6. A COMPARATIVE STUDY OF VERTEBRATE EMBRYONIC SERUM PROTEINS.

Edwin M. Weller; *Randolph-Macon Woman's College*

Electrophoretic analyses of embryonic bird and mammalian sera reveal several features of significance: 1. Embryo serum proteins partially resemble those of the adult and in addition have embryo-specific characteristics. 2. Bird and mammalian sera apparently show a common vertebrate electrophoretic pattern with superimposed class and species-specific features. 3. Serum in all vertebrate embryos (so far studied) develops epigenetically; a biochemical confirmation of morphological ontogenesis. Evidence for these summarizations was obtained by zone and free electrophoresis of chick, pheasant, duck, rat and rabbit embryonic and post-embryonic sera.

7. ACTION OF IPRONIAZID ON *Tetrahymena pyriformis.*

Joseph Krezanoski; *Medical College of Virginia*

A diversity of pharmacological and biochemical effects have been observed with the drug iproniazid (Marsilid, Hoffman-La Roche Inc.). Among the outstanding effects are elevation of mood, stimulation of appetite, hypotensive effect, and the promotion of the healing process. The current concept of mono-amineoxidase inhibition by iproniazid does not adequately account for all these actions. In order to learn more about the mode of action of this drug its effects were examined on a protozoan, *Tetrahymena pyriformis.* Data on the effect of iproniazid on the rate of cell division, whole cell respiration as well as cell homogenate exygen utilization will be presented. The report will include effects of various substrates such as acetate, tyramine, and glucose as well as certain co-factors such as nicotinamide and pyridoxine on iproniazid inhibition.

8. STUDIES ON THE CONTROL OF GROWTH IN TIMOTHY ROOTS.

Robert T. Brumfield;
Longwood College and Oak Ridge National Laboratory

The root cap and meristematic cells of the timothy root are covered by a gelatinous substance which inhibits the growth of elongating cells of a second root when transferred by contact. UV stimulates growth and the stimulation is transferred to nonirradiated roots. The substance is digested by RNase, its digestion being inhibited by IAA and stimulated by 2,4,6-trichlorophenoxyacetic acid. The latter compound inhibits UV stimulation and geotropism. Thus there is circumstantial evidence that the growth controlling substance is rich in RNA.

9. A COMPARISON OF INITIAL EFFECTS FROM GAMMA RADIATION UPON SOME GYMNOSPERMS AND ANGIOSPERMS.

W. S. Flory and W. Ralph Singleton;
The Blandy Experimental Farm, University of Virginia

In the early spring of 1958 several lots of nursery material were radiated in the Blandy Cobalt-60 radiation field. Fourteen conifers and 15 dicotyledonous angiosperms were included. Radiation dosages of 2500 r, 5000 r, 10,000 r and 20,000 r were used. The radiated conifers, practically without exception, either died within a few weeks or months after treatment, or else showed considerable injury from even the lowest dosage (2500 r) used. The several angiosperms, rather than being injured, often had a stimulation of growth following 2500 r or 5,000 r. With the angiosperms there was retardation of growth following 20,000 r, as well as dulling of foliage and considerable rosetting of terminal growth;

but practically all these plants from all dosages continued active throughout the 1958 season.

10. EMBRYOLOGICAL EVIDENCE FOR THE RELATIONSHIP OF AQUIFOLIACEAE TO CELASTRACEAE.

J. M. Herr, Jr.; *Pfeiffer College*

A comparison of the embryological features of the genus *Ilex*, the principle genus in Aquifoliaceae, with those reported for several genera in Celastraceae reveals several points of similarity. The most striking similarities involve the formation of the sporogenous tissue; the structure and growth pattern of the nucellus; the arrangement and behavior of the megaspores; and the development of the megagametophyte, especially the behavior of the synergids, polar nuclei, and antipodals. The preponderence of evidence indicates Aquifoliaceae to the more generalized status. However, in consideration of developmental features dissimilar in the two families direct derivation of Celastraceae from Aquifoliaceae is not tenable.

11. GROUND VEGETATION PATTERNS OF THE SPRUCE-FIR AREA OF THE GREAT SMOKY MOUNTAINS NATIONAL PARK.

Dorothy L. Crandall; *Randolph-Macon Woman's College*

Differences in undergrowth patterns form the basis for site types designated for the southern boreal forest. These eight site types, based upon frequency and coverage of species of shrubs and herbaceous plants, are as follows: (1) Oxalis-Hylocomium; (2) Oxalis-Dryopteris; (3) Hylocomium-Vaccinium; (4) Viburnum-Vaccinium-Dryopteris; (5) Senecio; (6) Viburnum-Vaccinium-Senecio; (7) Vibrunum-Vaccinium-Lycopodium; (8) Rhododendron. Various interrelationships of the species of the lower and upper strata of these site types were discussed.

12. THE CONTROVERSIAL SEX-BIVALENT IN THE GOLDEN HAMSTER.

Lyman Randlett Emmons; *University of Virginia*

Koller (1938) reported both post-reductional (18.4%) and pre-reductional (81.6%) separation of the sex chromosomes in the Golden Hamster. Matthey (1951) re-examined the sex bivalent and found only pre-reductional separation of the X and Y. He stated that the conclusion of Koller was "une simple et ingenieuse vue de l'esprit." Matthey's work has cast doubt upon the coexistence of pre-reduction and post-reduction in the same species. Further study by this author substantiates Koller's original observation. A second type of post-reductional bivalent is described. Post-reduction occurs in our material in 10.9% of the cells rather than in 18.4%.

13. THE CHROMOSOMES OF ZEPHYRANTHES SPECIES FROM THE WEST INDIES.

W. S. Flory; *The Blandy Experimental Farm, University of Virginia*

Six *Zephyranthes* species are known from the West Indies. The present report describes the chromosomes of Z. *rosea* (24), Z. *puertoricensis* (25), Z *insularum* (28), Z *citrina* (48), Z *carinata* (48) and Z *bifolia* (60) (the somatic chromosome number appearing in brackets after each species). Chromosomes with median, near-median, submedian and subterminal centromeres occur in each species. The number of sub-median, or of submedian plus near median, chromosomes approximate either half or more than half the total number for each species. The number of long median pairs varies from one pair in Z. *rosea* to five pairs in Z. *bifolia*, with the number of sub-terminal ones being slightly higher. The total length in microns of all chromosomes varies from 122 in Z. *rosea* to about 250 in species with the higher numbers. Karyotype relationships have been studied, and will be discussed. (This study supported in part by NSF Grant G2716.)

14. A STUDY OF PHYLOGENY AND OF KAROTYPE EVOLUTION IN LYCORIS.

Smritimoy Bose; *The Blandy Experimental Farm, University of Virginia*

Chromosome number and karyotype analyses have been made for 12 species and chromosome races in *Lycoris*. Somatic chromosome numbers involved here are - 12, 13, 14,15, 16, 17, 22, 27, 29+1B, 30 and 33. Karyotype analyses show five major types of chromosomes plus a very short euchromatic (B) chromosome. The basic number is suggested to be 6 or 11. Fusion and fragmentation of chromosomes, telocentric chromosomes, centromeric structure, in karyotype evolution and speciation, are recognized. Gene mutation, polyploidy and particularly hybridization, translocation and inversion are also considered in this connection.

15. EXPERIMENTAL INFECTIONS OF CHICK EMBRYOS WITH *Tetrahymena pyriformis*.

Jesse C. Thompson, Jr., Lynne Santy, and Valer Clark; *Hollins College*

Strain WH-1 of *Tetrahymena pyriformis* was inoculated into developing chick embryos at various stages of embryonic development (3rd, 5th, 7th, 9th, 11th, 13th, 15th, and 17th day of incubation) to determine the most susceptible stages for infection. Younger embryos were more susceptible but infections were established in all stages inoculated. Older embryos carried the infection through complete embryonic development and the yolk sac contained protozoa as long as 48 hours after hatching. Other embryos inoculated at 11th, 13th, 15th, and 17th day of incubation failed to show infections when examined 8 days after hatching.

16. PLANT MIGRATIONS IN MID-APPALACHIAN REGION.

E. L. Core, *West Virginia University*

(An invitation address sponsored by the Committee on Virginia Flora)

A large portion of the vascular flora indigenous to the middle Appalachian area has been here since late Mesozoic or early Cenozoic times. Some species in relict colonies may be remnants of a still older flora which has now mostly moved out onto the coastal plain. Boreal and subboreal species migrating southwards during glacial periods are now gradually withdrawing northwards along the mountain summits, while southern species are entering the area *via* river valleys penetrating the mountains. Prarie species from the mid-west are entering the artificial grasslands created through the removal of the forests.

17. VIRGINIA FLORA.

A. B. Massey, *Virginia Polytechnic Institute*

Field and herbarium work relating to the flora is progressing. Spare time and finances handicap those interested. The Committee on Virginia Flora sponsored the publication of the Flora of Richmond; for five years published *Claytonia*, a journal of Virginia botany. *Claytonia* was discontinued in favor of the *Virginia Journal of Science*. Sixteen individuals have each contributed 1 to 12 publications relative to the flora. Ten local or sectional herbaria have been developed. The Virginia Polytechnic Institute herbarium is state wide and is believed to be the largest hebarium in the state. Fernald, Allard, Hunnewell, and others have contributed many specimens to the Virginia Polytechnic Institute herbarium.

18. NOTES ON THE HELMINTHS OF MAMMALS IN THE MOUNTAIN LAKE REGION V. THE HELMINTHS OF RABBITS.

Harry L. Holloway; *Roanoke College*

The examination of ten rabbits (*Sylvilagus* species) during the summers of 1954 and 1956 disclosed the presence of five species of intestinal worms (one cestode and four nematodes) and one peritoneal cysticercus. Cestodes were: *Cittotaenia variabilis* and *Taenia pisiformis*. Nematodes were *Passalarus nonanulatus, Dermatoxys veliger, Trichostrongylus calcaratus,* and *Obeliscoides cuniculi*. The parasites appeared to have no effect upon the host and thus to be a real danger only during periods of undernourishment and old age when the energy requirements of the worm load become proportionately greater. Carl F. Clancey, et al (*Journal of Wildlife Management*, 1940) encountered four species of helminths in the examination of 342 rabbits in Connecticut. (Supported in part by awards from National Science Foundation and Mountain Lake Biological Station.)

19. EVALUATION OF RABBIT MANAGEMENT METHODS BY LIVE TRAPPING.

Donald K. Fortenbery; *Virginia Polytechnic Institute*

Rabbits were live trapped at Camp Pickett on three cultural type treatments in an effort to determine relative rabbit usage. Trapping was conducted in plots of winter grain-clover combination, rescue grass, annual mix of nine species and a control area. Forty-five days of trapping produced 135 individual cottontails of which 76 were recaptured. In the annual mix type, 40.75 per cent of the rabbits were captured; 34.10 per cent in the winter grain type; 11.85 per cent in rescue grass and 13.30 per cent in the control.

20. TECHNIQUES INVOLVED IN THE USE OF CHEMICALS FOR ESTABLISHING WILDLIFE CLEARINGS.

Harold A. Trumbo; *Virginia Polytechnic Institute*

Wildlife clearings have been established primarily by bulldozing and hand labor. These methods have been successful, but costly. Experiments indicated the feasibility of establishing wildlife clearings by the use of herbicides. A field experiment was initiated to make the following evaluations: (1) effectiveness of herbicides as tools, (2) cost comparison of herbicidal methods to others, and (3) utilization of these areas by game species. Four herbicides were used: Ammate, Monuron, Fenuron and 2,4,5-T. Monuron and Fenuron appear acceptable.

21. EFFECT OF FORESTRY PRACTICES AND WILDLIFE MANAGEMENT ON ABUNDANCE AND DISTRIBUTION OF DEER.

John H. Quillen, Jr.; *Virginia Polytechnic Institute*

A forested area of nearly 8,000 acres in Craig County has been set up for a 10 year study. Objectives are to study the effect of standard forestry practices and wildlife management techniques on the indigenous game species. This first phase of the project has been concerned primarily with abundance and distribution of deer. Data are being gathered through pellet group counts, track counts, trapping, direct observations and hunting season checks.

22. INCIDENCE AND CAUSES OF TULAREMIA IN HUMANS IN VIRGINIA.

Burd C. McGinnes; *Virginia Cooperative Wildlife Research Unit*

Virginia Department of Health reports of human tularemia cases were followed up by letters of inquiry to the respective county health authorities. Results of the three year study indicate the prevalence of the disease, distribution and major sources of infection.

23. THE EFFECT OF BLACKBIRDS UPON AGRICULTURE IN SOUTHWESTERN VIRGINIA.

Thomas C. Crebbs, Jr.; *Virginia Polytechnic Institute*

Investigations of reported damage to grain crops in Southeastern Virginia have proven that damage is almost directly proportional to weather conditions; and in the case of milo damage, to proximity of nesting colonies of Red-wing blackbirds. This season, damage to stacked peanuts by blackbirds was negligible. Though ignored by farmers, the monetary loss in field corn eaten by birds exceeded peanut losses. Grain sorghums were attacked only when adjacent to marshes, or by migrating Bobolinks.

24. A SURVEY OF THE FOOD HABITS OF *Rana catesbeiana* SHAW FROM FIVE DIFFERENT HABITATS.

Garnett R. Brooks, Jr.; *University of Richmond*

The food habits of 138 *R. catesbeiana* from five different types of ponds were studied. Habitats ranged from open pasture to dense woodland; intermediates were a composite of the two. With the exception of the food from the pasture pond, insects comprised the major food item by weight at all ponds (28-49 per cent). Although insects were numerous at the pasture pond, vertebrates constituted 64 per cent of the total food weight and insects only six per cent.

25. THE FOOD OF THE CHAIN PICKEREL, *Esox niger* LESUEUR IN TUCKAHOE CREEK, VIRGINIA.

David A. Flemer; *University of Richmond*

A survey was made from June through December, 1958, to determine the distribution and food habits of fishes in Tuckahoe Creek. Thirty one species, including 64 specimens of *Esox niger*, were collected. The pickerel, found only in the lower half of the creek, utilized insects, fishes, and crustaceans as food. Smaller specimens (less than 74 mm. in length) fed on insects 48 per cent of the time and fishes 30 per cent of the time. The diet of larger fish consisted primarily of fishes (63 per cent) and, to a lesser degree, insects (16 per cent). The data could not be treated statistically because of the lack of larger specimens.

26. RESPIRATION AND HEMOLYSIS OF ULTRAVIOLET IRRADIATED FROG ERYTHROCYTES.

Lewis Harvie and S. P. Maroney, Jr.; *University of Virginia*

Respiration and hemolysis of frog (*Rana pipiens*) erythrocytes suspended in phosphate buffered glucose-Ringer's solution were measured

following ultraviolet irradiation. Non-irradiated cells served as controls. Hemolysis increased with increasing radiation doses while at the doses used, oxygen consumption was not altered. These data are consistant with the concept that ultraviolet-induced hemolysis results from an alteration of the cell membrane rather than damage to the cell's source of metabolic energy.

27. OBSERVATIONS ON THE BIOLOGY OF *Pelomyxa palustris* GREEFF COLLECTED UNDER POLYSAPROBIC CONDITIONS.

Daniel H. Stern; *University of Richmond*

P. palustris Greeff was collected in the Southampton Quarry near Richmond, Virginia. It appears to exist under polysaprobic conditions. The organism could be maintained for 8 months in the laboratory only in tightly capped containers filled with water from the habitat. Experiments seem to indicate that a microquantity of oxygen and a low temperature are important factors for successful cultivation. Culture of *P. palustris* according to methods previously reported in the literature was successful. Partial success was obtained when the organism was cultured using *Ankistrodesmus sp.* or organic debris from the quarry floor as food.

28. STUDIES ON TARDIGRADES FROM VIRGINIA.

G. T. Riggin, Jr.; *Virginia Polytechnic Institute*

Studies have been made on the tardigrade fauna of Southwestern Virginia, especially the regions surrounding Mountain Lake, Blacksburg and Mt. Rogers, Grayson County. A total of thirty species included in the genera *Echiniscus, Pseudoechiniscus, Macrobiotus, Hysibius, Diphascon, Itaquascon,* and *Milnesium* have been collected from moss, studied and identified. The report of these forms constitutes the first such citation from Virginia.

CHEMISTRY

BUSINESS SESSION

The possibility of having a short discussion period following each paper was considered. To allow time for this, it was suggested that two sessions might be held concurrently on Friday or a Saturday morning session might be added to the program. But no definite decisions were reached. The report of the nominating committee was presented, and the following officers were elected for the 1959-60 period by unanimous vote of the members present: *Chairman,* – Mearl A. Kise; *Secretary,* W. Allan Powell.

1. THE EFFECT OF FOREIGN METALS ON THE CORRUSION OF TITANIUM IN BOILING 2M HYDROCHLORIC ACID.

W. Roger Buck, III, Billy Sloope and Henry Leidheiser, Jr.;
Virginia Institute for Scientific Research

The rate of corrosion of titanium was determined in boiling 2M HCl when contacted with aluminum, cadmium, tin, zirconium, lead, bismuth, mercury, silver, copper, antimony, vanadium, 70:30, 50:50 and 30:70 copper-nickel alloys, iron, palladium, cobalt, nickel, gold rhodium, platinum and iridium. Less extensive corrosion measurements of the same type were also made in 0.6 and 2M H_2SO_4. The potentials of the couple and of the two members of the couple were determined in boiling 2M HCl for 20 of the systems studied. A plot of the corrosion rate vs. the couple potential yielded a polarization curve which was similar to the anodic polarization curve for titanium with an impressed voltage. The curve exhibited a maximum in corrosion rate at a couple potential of -0.49 volt vs. the saturated calomel electrode. The potential of titanium in boiling 2M HCl was also determined as a function of concentration of the following metallic cations in the acid: copper, silver, antimony, nickel, gold, palladium, rhodium, platinum, and iridium. The influence of the cations on the corrosion rate was explained in relation to the polarization curve.

2. OXIDATIVE STUDIES OF DIPYRIDYLAMINES.

Robert N. Lawhorn, Ertle Thompson, Oscar Rodig and James W. Cole, Jr.;
University of Virginia

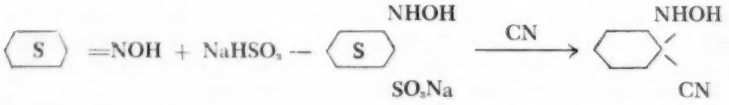
The dipyridylamines have shown interesting properties as high temperature antioxidants. Several new dipyridylamines were prepared by reacting substituted pyridylamines with their respective hydrochlorides.

In oxidation studies at 204°C., 2,2'-dipyridylamine and its symmetrical dimethyl derivatives were compared as antioxidants in di-(2-ethylhexyl) sebacate. The additive-di-ester solution was oxidized under controlled conditions and samples analyzed for peroxides and other property changes. The results were compared with each other and with those of similar runs with copper, in the elementary and combined form, also present in the system. There was distinct enhancement of the apparent antioxidant activity of the dipyridylamine when copper was present. Ultraviolet and infrared spectrophotometric studies as a means of determining the rate of disappearance of the additive and of identifying the oxidative products was discussed.

3. N-SUBSTITUTED α -AMINO NITRILES[1]

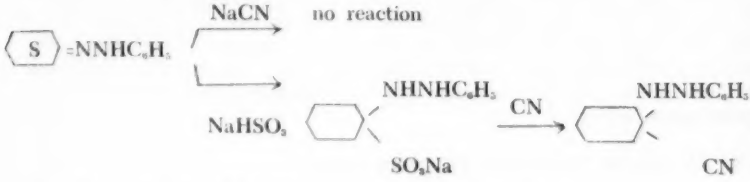
L. Neelakantan; *Medical College of Virginia*

Cyclohexanone oxime reacting with alkali cyanide in the presence of sodium bisulfite affords excellent yields of 1-hydroxylamino-1-cyanocyclohexane. The reaction does not take place in the absence of bisulfite. The formation of -amino nitriles from -aminoalkansuelfonates is known Therefore, the following mechanism was proposed:



Similar results have been obtained with cyclopentanone oxime, aliphatic aldoximes and simple ketoximes.

The reaction can be extended to compounds such as phenylhydrazones and semicarbazones, e.g.,



4. QUANTITATIVE MICROANALYSIS OF ALOKOXY GROUPS.

Robert E. Bailey and Bryant Harrell;
College of William and Mary

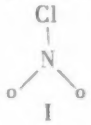
[1](Supported by NIH Grant CY 3024.)

The apparatus for the Zeisel determination of alkoxy groups has been simplified to consist mainly of six mm tubing jointed with standard taper joints. The reaction mixture is a mixture of phenol and concentrated hydrogen iodide, the wash solution saturated sodium carbonate and the receiver chamber is used for volatile compounds, which are weighed in sealed melting-point-type tubes. A precision of two or three parts per thousand was obtained with methoxy, ethoxy and propoxy.

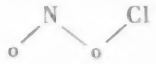
5. A STUDY OF THE STRUCTURE OF NITRYL CHLORIDE.

John C. Kotz and Richard P. Carter; *Washington and Lee University*

An investigation was undertaken to confirm the structure of nitryl chloride through the use of its dipole moment. Two structures for the compound were postulated:



I



II

The microwave spectrum indicated the planar structure I, whereas, organic substitution reactions indicated either I or II with I being the more probable. The infrared spectrum, however, was ambiguous. By combining the above mentioned spectra with that of the visible and ultraviolet regions and using the dipole moment of the compound, structure I has been confirmed as the true structure of nitryl chloride.

6. SYNTHETIC HOMOLOGS OF α-AMINO ACIDS AND THEIR DERIVATIVES AS ANTI-TUMOR AGENTS.

John Andrako, J. Doyle Smith and W. H. Hartung; *Medical College of Virginia*

A number of substituted acetamidomalonic esters, *dl*-α-acetamido acids and *dl*-α-amino acids were prepared and submitted for testing in the screening program of the Cancer Chemotherapy National Service Center. The substituted acetamidomalonic esters were synthesized by conventional alkylation of diethyl acetamidomalonate with alkyl and aralkyl halides. Saponification of the substituted esters gave the *dl*-α-acetamido acids. Acid hydrolysis of the esters was employed to obtain the *dl*-α-amino acids. The available results of screening tests performed on these compounds in the tumor systems employed by the Cancer Chemotherapy National Service Center were reported. (Supported by the Department of Health, Education and Welfare Contract No. SA-43-ph-1807.)

7. SELECTED ADDITION COMPLEXES OF NITRYL CHLORIDE.

Richard P. Carter and John C. Kotz; *Washington and Lee University*

Using nitryl chloride as the primary reactant and metal halides and interhalogen compounds as secondary reactants, various addition complexes of the general nature of nitronium fluoborate, $NO_2(BF_4)$, were obtained. Some physical properties and constants of these compounds, as well as reactions with organic compounds, were investigated. These reactions were carried out to determine more conclusively the mechanism of aromatic nitration, as well as the value of these addition complexes as nitrating agents.

8. THE INFRARED ABSORPTION OF PHOSPHORUS COMPOUNDS.

Margaret Anne Barber; *Virginia-Carolina Chemical Corporation*

A correlation has been made of the infrared absorption of organic and inorganic phosphorus compounds with their chemical structures. Results from a number of sources have been collected and compared. Typical literature values have been compared with actual absorption spectra obtained on the Perkin-Elmer "Spectracord" (one of the recently developed "low cost" infrared spectrometers). Charts have been prepared of the characteristic absorption of atomic groupings most frequently encountered in phosphorus compounds. Practical applications of these data have been made in utilizing infrared absorption to follow the oxidation of a P(III) compound to a P(V) compound and to analyze mixtures of the allotropes of sodium triphosphate.

9. SPECIFIC CENTERS IN PALLADIUM CATALSTS.

Robert L. Beamer and Walter H. Hartung;
Medical College of Virginia

Two thoughts suggest that catalysts prepared by depositing palladium on a suitable carrier may have highly specific centers. First, it has been observed from previous work that the qualitative properties, e.g., the rate at which a given substrate is hydrogenated are appreciably influenced by the method of preparation of the catalyst. Second, from analogy with biocatalysis or enzyme reactions and assuming random deposition of the metal, it is postulated that only those centers onto which a substrate molecule "fits" may act catalytically. A design of experiments and apparatus to test these hypotheses was presented and supporting data were discussed.

10. RESEARCH IN CANCER CHEMOTHERAPY.

John E. Yurko and Bryant Harrell; *College of William and Mary*

The National Program of Cancer Chemotherapy along with some of its purposes was briefly explained. The most widely used present-day methods of cancer control were mentioned and the most promising types of cancer chemotherapeutic drugs were listed along with the type of action exhibited. The syntheses of some methane sulfonates and similar compounds were undertaken in the laboratory. The compounds were submitted to the Cancer Chemotherapy National Service Center for screening.

11. RECENT ELECTRON AND OPTICAL MICROGRAPHS OF A CATALYST SURFACE.

Allan T. Gwathmey and Shaukat Azim; *University of Virginia*

Past studies with single crystals of copper have shown that certain faces only are stable during the catalytic reaction of hydrogen and oxygen. Preliminary studies with the electron microscope revealed many interesting types of surface structures not previously observable with the optical microscope. More recent studies with the electron microscope have been made of the catalyst surface under different conditions of experimentation. The influence of imperfections and long periods of time on surface structures was more carefully investigated and were described with the aid of micrographs.

12. ELECTRON MICROSCOPE OBSERVATIONS ON THE DECOMPOSITION OF MOLYBDENUM TRIOXIDE AND CUPROUS OXIDE.

Kenneth R. Lawless; *University of Virginia*

When some materials are observed in the electron microscope with a high intensity beam, changes may take place in the specimen. Molybdenum trioxide single crystals exhibit several changes due to the heating up of the strained specimens in the vacuum. The changes observed were: 1) sublimation, 2) recrystallization, 3) apparent precipitation of a new phase along specific crystal planes and 4) complete conversion to MoO_2. Thin films of cuprous oxide under some conditions also decompose, forming copper nuclei which continue to grow as the specimen is heated by the electron beam. These changes may be followed both by electron microscopy and electron diffraction.

13. CAROTENOID PIGMENTS OF AGED BURLEY TOBACCO.

H. E. Wright, Jr., W. W. Burton and R. C. Berry, Jr.;
The American Tobacco Company

The carotenoids of aged Burley tobacco were separated by column chromatography. Eighteen pigment bands were observed in an amount corresponding to 43.3 ug./g. of dry leaf, less than 25% of the carotenoid

content of green Burley tobacco. One of the major carotenoids, Pigment X, apparently was a nonether *cis* polyol adsorbing above zeaxanthin. α-Carotene, β-carotene, cryptoxanthin, lutein, zeaxanthin and Pigment X, including respective stereoisomers, comprised 98% of the carotenoids. Minor constituents included five pigments whose partial identification indicated that they may be: a monohydroxy-α-carotene, an epiphasic lutein isomer, β-carotenone aldehyde and two *cis*-lycopenes. Violaxanthin and neoxanthin, major xanthophylls of fresh, green tobacco, were not found in the aged tobacco.

14. QUALITATIVE ELEMENTARY ANALYSIS OF ORGANIC COMPOUNDS BY A COMBUSTION METHOD.

Frank Denaro and Bryant Harrell; *College of William and Mary*

Organic materials were converted into soluable combustion products which were then analyzed for chlorine, bromine, iodine, sulfur, nitrogen, carbon and hydrogen by usual qualitative methods. The combusion proceeds at high temperatures in an atmosphere of oxygen and the combusion products were absorbed in a solution of sodium hydroxide.

15. A STUDY OF THE ACID CATALYZED CLEAVAGE OF 10-CYCLOHEXYL-1,2-BENZANTHRACENE.

F. A. Vingiello and T. Delia; *Virginia Polytechnic Institute*

In conection with the extensive studies conducted on aromatic cyclodehydration, it became clear that certain *meso* substituted 1,2-benzanthracenes are subject to acid cleavage. The synthesis and cleavage of 10-cyclohexyl-1,2-benzanthracene was reported. The synthesis of several new ketones and the cleavage of several other *meso* substituted 1,2-benzanthracenes was discussed.

16. SURFACE TENSION, INTERMOLECULAR DISTANCE AND ASSOCIATION ENERGY OF A PURE NON-POLAR LIQUID.

Ralph G. Steinhardt, Jr.; *Hollins College*

It is known that a linear relation exists between molecular refraction and the parachor of pure liquids. A simple mathematical development of this relation leads to the conclusion that, for pure non-polar liquids, the decrease in surface tension with increasing temperature can be attributed solely to the corresponding increase in intermolecular distance. It can also be shown that a simple approximate relationship exists between surface tension and the London energy. Therefore, for a pure non-polar liquid, the surface tension is a simple, approximate function of the total intermolecular association energy.

17. SOME COLORLESS POLYENES OF AGED BURLEY TOBACCO.

H. E. Wright, Jr., W. W. Burton and R. C. Berry, Jr.;
The American Tobacco Company.

Several colorless polyenes of aged Burley tobacco were separated by column chromatography. Neophytadiene, phytoene and phytofluene were identified. In addition, two colorless polyenes were found whose partial identification indicated that they may be isodesmethylaxerophthene and α-ionone. Neophytadiene was the principal colorless polyene identified.

18. PROOF OF STRUCTURE OF 4-HYDROXY-2-METHYLTETRAHYDROTHIOPHENE 1,1-DIOXIDE.

Robert C. Krug and James A. Rigney, *Virginia Polytechnic Institute*

In the presence of a strong base, 2-methyl-2,5dihydrothiophene 1,1-dioxide and 2-methyl-2,3dihydrothiophene 1,1-dioxide (I) were converted to a mixture of an alcohol (II) and 2-methyl-4,5-dihydrothiophene 1,1-dioxide. Since I was obtained from the pyrolysis of the acetate from II, the new alcohol was assigned the structure 4-hydroxy-2-methyltetrahydrothiophene 1,1-dioxide. To confirm the assignment, an independent synthesis was undertaken which established the structure of II as proposed. The eight step synthesis proceeded through a cyclic ketosulfide which had been prepared by Larrson (Svenk. Kem. Tid., 57, 248 (1946), to a dinitrobenzoate which was identical with the same derivative prepared from II.

19. INHIBITION OF THE NITROSTYRENE CONDENSATION IN ACETIC ACID BY TRACES OF WATER.

Charles E. Bell, Jr., and Thomas I. Crowell;
University of Virginia

The formation of the nitrostyrene from nitromethane and piperonal, in the presence of n-butylamine, was followed gravimetrically in glacial acetic acid. The rate decreased very markedly with increasing water concentration in the range 0.03 to 2% water. Equilibrium measurements showed a corresponding decrease in the concentration of the intermediate Schiff base, partially accounting for the observed inhibition.

20. QUANTITATIVE SEPARATION OF SOME PYRIDINE COMPOUNDS BY PAPER CHROMATOGRAPHY.

Eugene Glock and T. H. Vaughan, Jr.;
The American Tobacco Company

A paper chromatographic procedure was developed for the separa-

tion and quantitative determination of nicotine, pyridine, β-picoline and several other pyridine derivatives which may be found in cigarette smoke. The pyridine compounds were separated in bands as their hydrochlorides by one-dimensional descending paper chromatography employing a n-butanol-HCl-H_2O as the developing solvent. The pyridine compounds were located on the chromatograms in microgram quantities by their absorption of short-wave ultraviolent light and their characteristic fluorescence and phosphorescence in liquid nitrogen. The separated chromatographic bands of the pyridines were eluted with HCl and the amounts were determined by ultraviolet spectrophotometry. This method has been applied to the determination of several pyridine compounds in cigarette smoke.

21. THE PREPARATION OF A 10-(*HYDROXYMETHYLPHENYL*)-1,2-BENZANTHRACENE.

F. A. Vingiello and C. Lewis; *Virginia Polytechnic Institute*

Recently, 10-phenyl-1,2-benzanthracene was prepared. The compound was tested for carcinolytic activity by the National Institute of Health. It showed slight anti-tumor activity when tested against several tumors. In view of this information, it obviously became interesting to try to prepare a 10-hydroxymethylphenyl-1,2-benzanthracene and to test its physiological activity. The synthesis of this compound was reported upon.

22. KINETICS IN A DUAL TEMPERATURE SYSTEM.

Thomas I. Crowell; *University of Virginia*

A chemical equilibrium having forward rate constants k_1 and k_1' and reverse rate constants k_2 and k_2' at temperatures T and T' will reach a steady state if the temperature fluctuates rapidly between these two temperatures. The steady-state concentrations are given by an apparent equilibrium constant, $K_e = (k_2' + nk_2)/(k_1' + nk_1)$ where the system remains n times as long at the lower temperature as at the higher. Experimental data and possible applications were given, including evaluation of the activation energy from K_e and n.

23. AN INVESTIGATION OF THREE DERIVATIVES OF CHROMOTROPIC ACID AS POSSIBLE COLORIMETRIC REAGENTS FOR THE SIMULTANEOUS DETERMINATION OF URANIUM AND THORIUM.

H. Perry Holcomb and John H. Yoe; *University of Virginia*

A method for the spectrophotometric determination of uranium using 3-(2-arsonophenylazo)-4,5-dihydroxy-2,7-naphthalene-disulfonic acid (trisodium salt) has already been developed. This reagent and two other derivatives of chromotropic acid, 4,5-dihydroxy-3-(p-sulfophenylazo)-2,7-

naphthalenedisulfonic acid (trisodium salt) and 4,5-dihydroxy-3-(p-nitrophenylazo)-2,7-naphthalenedisulfonic acid (disodium salt), are being examined as possible colorimetric reagents for the simultaneous determination of uranium and thorium. Spectral studies of these compounds and of their uranium and thorium complexes were presented.

24. COLOR REACTIONS OF 1,4-DIHYDROXYANTHRAQUINONES.

E. Guy Owens, II; *University of Virginia*

1,4-Dihydroxanthraquinones from intensely colored complexes with a variety of metallic ions. Color reactions of a series of substituted 1,4-dihydroxyanthraquinones with beryllium and aluminum were studied with regard to analytical applications.

25. SPECTROPHOTOMETRIC DETERMINATION OF MANGANESE (II).

Dwight O. Miller; *University of Virginia*

The concentration of manganese in human plasma and red cells is extremely low, so low that a more sensitive procedure than the permanganate colorimetric method is needed. Manganese (II) reacts with diethyldithiocarbamate to yield a colored complex which has been used for the spectrophotometric determination of the metal. Diethyldithiocarbamate and other substituted dithiocarbamates were studied as reagents for the spectrophotometric determination of manganese (II) and the extractabilities of the manganese complexes with various organic solvents were investigated.

26. SPECTROCHEMICAL DETERMINATION OF TRACE AMOUNTS OF NICKEL IN NORMAL HUMAN PLASMA AND RED BLOOD CELLS.

Leonel M. Paixo; *University of Virginia*

A spectrochemical method for the simultaneous determination of magnesium, chromium, nickel, copper and zinc in human plasma and red blood cells was developed in the Pratt Trace Analysis Laboratory. The limit for nickel was 0.02 p.p.m. and in some samples, nickel was not detected. Because so little is known about the nickel content of human blood fractions, an effort was made to increase the sensitivity of the method. The details of the studies were reported upon.

27. SOME OBSERVATIONS OF CRYSTAL IMPERFECTIONS DURING OXIDATION AND CATALYTIC REACTION ON COPPER.

R. H. Kean; *University of Virginia*

The locations of imperfections or discontinuities in the atomic lattice of crystal surfaces, whether caused by atomic dislocation, by edges or

corners of atomic planes or by impurities, all represent points of abnormal surface energy. As such, their role in the mechanism of chemical reactions occurring on solid surfaces is of considerable theoretical interest. Thus, the identification of these points on crystal surfaces and their correlation with points of preferential chemical activity, as in the first stages of oxidation of a metal, or in the dissolving of metal by etching or in the catalytic activity of the surface, have recently been increasingly the objects of experiment. The results of a few preliminary experiments in this field were presented.

EDUCATION

1. THE RELATION BETWEEN ACE SCORES AND ACADEMIC SUCCESS IN COLLEGE.

Alfred L. Wingo; *State Department of Education*

Essentially a progress report since the study had not been completed.

2. SOME SOCIO-PSYCHOLOGICAL FACTORS AFFECTING THE DEVELOPMENT OF CHILDREN'S INTERESTS.

Judy Hollen and G. W. Kent; *Bridgewater College*

The purpose of this study was to examine a number of factors which are generally viewed as important in the formation and change of children's interests. These factors were age, grade, school, sex, and interest area. The California Pictorial Interest Inventory was administered to approximately 500 children in grades 4 through 7 enrolled in five elementary schools in Rockingham County, Virginia. Only sex and interest area were found to differ significantly. It was concluded that the large differences observed in sex and interest area, and the lack of significant differences in age, grade, and school is a function of the test employed to study interest. This test is designed as a vocational guidance tool rather than as an instrument for studying children's interests.

3. A STUDY OF TEACHER EVALUATION TECHNIQUES.

Donald Banks and G. W. Kent; *Bridgewater College*.

Eight faculty members at Bridgewater College participated in an evaluation study in which three different rating scales were employed together with two methods of ranking. Students rated these teachers using the rating scales. A selected group of student leaders also evaluated the teachers by means of the paired comparison and rank order tech-

niques. The teachers themselves used these two ranking techniques, and the college President and Dean likewise ranked the teachers via these two techniques. The faculty members were found least consistent in their rankings, while the administrative officers were the most consistent. The correlations among the various methods were in excess of .90, all were significant at the .001 level of confidence. Three hypotheses were advanced for these data: (1) The high correlations result from a confounding of judgements about teaching skill with personal liking for the teacher. (2) The period of time a teacher has been on the faculty will influence his rank (the first year teacher as opposed to the older teacher). (3) The basis for ranking the teachers was prestige and reputation rather than personal experience. Since all methods yielded similar results, it is concluded that the method to be employed is a function of other considerations than reliability and validity of measurement.

4. BACKGROUND OF COLLEGE TEACHERS.

W. D. Clague; *Bridgewater College*

The data for this report were collected by the use of questionnaires returned by a random sample of the teachers of the accredited four-year colleges of the south. This report is part of a larger study entitled "Sources of Teaching Personnel for Church Related Colleges of the South." College teachers in general come from the middle or lower educational and social groups of our society. They come from homes in which the parents have achieved a formal education below graduation from high school. More college teachers come from rural farm homes than from any other single occupational group. Business, skilled and unskilled labor, and the professions other than the ministry and teaching are the occupations next in order. Less than ten percent of college teachers come from homes in which the parents were teachers at any level and very few come from the homes of college teachers. The decision to enter college teaching as a career was generally made comparativly late in the college teacher's educational program. Less than one-half of those who eventually became college teachers had decided to do so by the time of graduation from college. Even so the most important factor in the choice of college teaching as a career was encouragement by one's college teachers to enter college teaching by the individual himeslf. It seems safe to conclude that college teachers come from a level of society in which college teaching is viewed as an opportunity to improve one's self and as a result of personal contacts between college teachers and their students.

5. RECONSTRUCTING THE CURRICULUM OF MAHACHULALONGKORN RAJAVIDYALAYA BUDDIST UNIVERSITY UNDER ROYAL PATRONAGE AT BANGKOK, THAILAND.

Kurt F. Leidecker; *Mary Washington College*

Two Buddhist universities serve the Thai clergy who cannot attend the secular colleges and universities, one being Mahamakuta Rajavidyalaya controlled by the Dhammayukta Sect of Hinayana Buddism with approximately 18,000 monks and novices and favored by the aristocracy, the other Mahachulalongkorn Rajavidyalaya, controlled by the Mahanikaya with approximately 222,000 members. It was the latter which asked the writer to serve as Foreign Adviser during 1956 and 1957 while he did a tour of duty as Cultural Affairs Consultant with the U. S. Information Service and Embassy at Bangkok. In numerous conferences with the Rector and staff a streamlined curriculum and an administrative organization were evolved basically along American lines, incorporating the desiderata and omitting certain subjects not applicable to members of the monastic order, yet stressing others not previously incorporated into the curriculum.

The fully worked-out curriculum is an integrated one emphasizing the humanities and Asian studies. It is so constructed that gradually more phases of it can be activated when and if the extremely modest funds and limited facilities are increased and instructors become available. It was anticipated that aid could be obtained from various sources. This hope, has, in part, been materialized. A large classroom building is now being completed; more instructors have made themselves available on a gratuitous basis; a modest system of publications has been initiated; and the holdings of the library which was organized on the Dewey Decimal System have been materially increased. Administration and the younger members of the Buddist Ecclesiastical Order especially are eager for a fuller and better education and are aware of the necessity of the knowledge of English. Foundational and other support would be welcome and go a long way toward increasing the educational facilities of an influential yet educationwise somewhat neglected sector of the Trai population.

6. Symposium: RELATIVE MERITS OF LABORATORY VS. DEMONSTRATION IN THE TEACHING OF SCIENCE.

A. L. Wingo; Moderator

Earl Savage; *Richmond Public Schools*

Sydney S. Negus; *Medical College of Virginia*

Franklin D. Kizer; *State Department of Education*

Richard Irby; *Department of Research and Development, American Tobacco Company*

Lindele A. Pitt; *Richmond Public Schools*

ENGINEERING

1. THE MEASUREMENT OF GAS ION CURRENTS.

Robert L. Ramey and Robert L. Overstreet; *University of Virginia*

The use of a pair of electrometer tetrodes in a balanced amplifier permits measuring currents down to 6 x 10^{-18} amperes, considerably smaller than the minimum grid currents of the tubes. The control grid of each electrometer tube is permitted to float, each grid circuit being completed via the effective leakage resistance R_1 and R_2 of the corresponding tube. The grid to ground capacitance C_1 and C_2 of each tube is adjusted so that $R_1C_1 = R_2C_2$ and the accelerating grid of each electrometer tube is adjusted to balance the quiescent plate currents of the tubes. Any signal current is applied to the control grid of No. 1 tube is given by

$$i_s = \frac{S\ C_1}{g_{m_1}} \quad \frac{R_{c_1}\left(1 - R_{eq_1}/r_{p_1}\right) + R_{c_2}\left(1 - R_{eq_2}/r_{p_2}\right)}{R_{eq_1}} \quad \frac{dx}{dt}$$

where S is the deflection sensitivity of a galvanometer connected directly between the anodes of the two electrometers, $\frac{dx}{dt}$ is the observed deflection rate of this galvanometer, and g_{m_1} is the transconductance. R_c is the anode coupling resistor, r_p the dynamic plate resistance, and $R_{eq} = \frac{r_p R_c}{r_p + R_c}$ of each tube. The time available for linear measurements is $T = 0.2\ R_1C_1$

For new electrometer tubes the effective grid leakage R_1 runs about 5 x 10^{15} ohms and a typical value for C_1 is 4 mmfd., yielding a measurement time of 4,000 seconds.

2. RESEARCH IN CONTINUOUSLY REINFORCED CONCRETE PAVEMENTS.

Howard Newlon; *Virginia Council of Highway Investigation and Research*

In currently designed concrete pavements, provision must be made to accommodate movements caused by changes in atmospheric conditions. Transverse joints are included so that relatively low tensile strength

of the concrete is not exceeded. In recent years interest has been revived in a design method whereby transverse joints are eliminated. Because of the absence of joints, cracks form as the pavement contracts but if sufficient reinforcing steel is included the cracks will be held tightly closed and will not constitute a structural weakness. Thus far the approach to this new design has been experimental in nature but certain factors, i.e. thickness, amount of steel, and general behavior, have been tentatively established.

In order to understand more clearly the fundamental behavior of this type of pavement, the Virginia Department of Highways plans an experimental pavement on Route 95 near Emporia. As a part of this project, theoretical studies have been made by Dr. William Zuk and a model pavement constructed in the form of a sidewalk. This paper presented (1) some basic facts concerning the design of continuously reinforced and conventional pavements; (2) a brief summary of information obtained from past research; and (3) plans for future research in Virginia.

3. THEORETICAL ANALYSIS OF TORSION IN SKEWED BRIDGES.

William Zuk; *University of Virginia*

To meet the requirements of modern highway transportation, bridges are often built with the abutments skewed to the longitudinal direction of the roadway. Among the previously unsolved problems of this type of bridge is the problem of the torsional effects that exist in the main stringer beams of such bridges, particularly ones built with the beams integral with the bridge decks. Theoretical solutions for the torsion in the beams of uniformly loaded bridges are found for two conditions of end bearing orientation. The first condition of bearing orientation is the standard one in which the bearings are parallel to the direction of the abutments. Solutions are obtained by considering the bridge system as an orthotropic plate, with the governing orthotropic differential plate equations transformed into skewed coordinates to more easily satisfy the boundary conditions. When the free spans of the decks are not greater than the widths of the roadways, the solutions of the deflected surfaces of the bridges are considerably simpilified. From the equations of the deflection surfaces, torsion formulae for the stringer beams are thus obtained.

4. THE EFFECT OF MECHANICAL VIBRATION ON LIQUID FILM HEAT TRANSFER COEFFICIENTS.

Dennis M. Frame; *University of Virginia*

The theory that vibration should increase heat transfer between flowing liquid systems is based on the fact that vibration should destroy or reduce the laminar film at the pipe wall. The work described consis-

ted of designing a counter-current concentric tube heat exchanger in which the inner tube could be vibrated in a direction parallel with the directions of flow. Tests were run with both frequency and amplitude varying and with amplitude varying while frequency was held constant. The range of flow rates investigated covered values of Reynolds numbers from 2,000 to 22,000. The data obtained indicate that there is a small increase in heat transfer coefficients with the vibration when the Reynolds numbers are in the range of 6,000 to 14,000. This increase appears to be at most only around four percent of the original coefficient value. The data indicate a very small effect of amplitude and indicate that frequency is the variable effecting the changes in the film coefficient. The results of this work indicate that vibration would be impractical for exchangers operating at Reynolds number above 2,000.

5. ENERGY AMPLIFICATION IN A TWO-COMPONENT NOZZLE FLOW.

John E. Scott, Jr.; *University of Virginia*

Energy amplification of a supersonic molecular beam source is given theoretical consideration. A two-component jet composed of a light carrier gas which is "seeded" with a heavy gas serving as the active component is employed. The concept is that the heavy molecules will have their energy augmented by collisions with the lighter ones during the expansion process. The analysis shows that the energy augmentation, expressed in terms of an energy amplification factor, can become quite large for the case of large differences in mass of the active component and carrier gas. The fraction of the total energy available which appears as kinetic energy of the heavy component is close to unity for large mass ratios even though only a small quantity of heavy gas is used. Introduction of a velocity lag parameter shows that even a small lag in velocity between the heavy and light molecular components results in a marked decrease in energy augmentation. However, it is concluded that energy amplification factors of significance can be obtained using the "seeding technique" which will enable the extension of the range of aerodynamic molecular beam source experiments.

6. THE STATIC AND DYNAMIC STABILITY OF SEVERAL BODY SHAPES IN NEWTONIAN FLOW.

E. Brian Pritchard; *Virginia Polytechnic Institute*

It is the purpose of this paper to investigate several missile nose configuartions to determine the most efficient body from the standpoint of stability. Three configurations were chosen to be studied. These are: (1) a hemisphere; (2) the cone inscribed in the hemisphere; (3) the minimum-drag cone frustum for the same fineness ratio as the hemisphere. For each of the above bodies, Newton's impact theory was ap-

plied to define its static and dynamic stability. In this investigation, three physical mass distributions were chosen for each body type; namely, (1) a solid, homogeneous body; (2) a shell body without a base; (3) a shell body with a closed base. In order to investigate the static and dynamic stability it was necessary to define the stability derivatives C_{N_α}, C_{N_q}, C_{M_α}, and C_{M_q}. Having defined these parameters the stability of each missile nose configuration was obtained for each physical mass distribution.

7. THE APPLICABILITY OF SANDWICH CONSTRUCTION TO MISSILE SHAPES.

Joseph S. Pratt and E. Brian Pritchard; *Virginia Polytechnic Institute*

The applicability of sandwich construction for missile shapes is investigated from an applied load consideration. A general missile configuration, consisting of a cone with a cylindrical afterbody is considered. Honeycomb and corrugated core types of sandwich construction are used in the analysis of the cone and cylindrical afterbody. The buckling loads are established and the results compared for both core types. It was found that the structure displayed a large margin of safety for both core types under the loading encountered at an altitude of 100,000 feet and a Mach number of 10 for the given diameter of the missile. It was concluded that, from a strength to weight ratio consideration, the aluminum honeycomb core sandwich construction is more efficient that the corrugated core type.

8. ON THE OPTIMIZATION OF TRAJECTORIES.

Robert B. Richards and James B. Eades, Jr.; *Virginia Polytechnic Institute*

A method is presented for the optimization of the trajectory and the mass distribution of a vertical sounding rocket. In general the optimal path will be composed of path segments flown with maximum thrust, variable thrust and in coasting flight. As a consequence of the optimization the composition of the complete extremal path is defined. The problem presented is that of determining the optimum path for maximum altitude with a two-stage rocket vehicle. This problem is solved with the assumption of an isothermal atmosphere and a constant drag coefficient corresponding to supersonic flight. For the complete optimization of both the trajectory and the mass distributions, the problem is necessarily solved by a double iteration procedure. A sample problem was presented to show the procedure for calculation, and to illustrate the influence of staging on the solution.

9. ON THE PROBLEM OF EARTH SATELLITES.

Roland N. Bell and James B. Eades, Jr.; *Virginia Polytechnic Institute*

This paper is a presentation of a highly refined method for approximating the trajectory of a satellite-carrying vehicle. Refinement is attained by the treatment of thrust, drag and gravity as variables and the division of the flight into several phases. By making only the most essential simplifying assumptions, integrable relations for terms describing the characteristics of the trajectory are obtained. The integration and application of these relations has been limited to small intervals so as to keep the incurred error negligible and, hence, the solutions are obtained by a stepwise integration process. A brief analysis of the elements of the elliptic orbit completes the derivation. To employ and test the equations obtained, a sample problem was worked based on a three-stage vehicle similar to the Vanguard. The results obtained from the solution of the sample problem are presented in tables and graphs.

10. LAMINAR BOUNDARY LAYER CONTROL BY MAGNETOGASDYNAMIC TECHNIQUES.

Charlie M. Jackson, Jr., and Robert W. Truitt;
Virginia Polytechnic Institute

In this paper a method of analyzing the two dimensional high-speed laminar boundary layer with an applied transverse magnetic field is presented. A closed-form solution is obtained for the governing equation of the compressible boundary layer over a body with pressure gradient. An analysis is made to determine a method of maintaining a constant boundary layer thickness ever an arbitrary body by magnetogasdynamic techniques. It is found that by controlling the applied magnetic field strength the boundary layer can be maintained constant. Using the governing equation of the boundary layer, an expression is developed for the necessary variation of the magnetic field strength. The problem of maintaining a constant boundary-layer thickness over a hemicylindrical leading edge of a wing is considered. The solution, that is — the necessary variation of the magnetic field strength — is presented for a constant electrical conductivity and for the more realistic condition of a variable electrical conductivity. An analysis is made of the variation with temperature and density of the electrical conductivity of ionized air. Closed from expressions are obtained for the viscous and magnetic drag coefficients of the hemicylinder with constant boundary-layer thickness.

11. COMPRESSIBILITY EFFECTS IN MAGNETOGASDYNAMIC FLOW.

Linwood B. Callis and Robert W. Truitt; *Virginia Polytechnic Institute*

The subject of this paper is the determination of the effects of

shock-interaction of the laminar boundary-layer characteristics under the influence of an applied magnetic field. In order to determine expressions for the magnetogasdynamic boundary-layer characteristics, the general van Karman integral momentum equation is used with the addition of a magnetic body force term. From a consideration of this equation and other basic relations, expressions for the skin friction, boundary-layer thickness, and boundary-layer temperature were obtained. Having these expressions, relations were then obtained giving the ratios of pressure, velocity, temperature, density, and viscosity as functions of a shock-interaction parameter; the ratios being that of a quantity in a region where no interaction is present. In order to determine the effects of shock-interaction on the boundary-layer characteristics, similar ratios of these characteristics were taken. Introducing the shock-wave boundary-layer interaction parameter, by means of the basic ratios previously mentioned, the effects of shock-interaction on the boundary-layer characteristics may be determined. The results, and the implications of these results, are given at the end of the paper.

12. THE FUNDAMENTALS OF THE SEPARATION OF HYDROGEN AND CARBON DIOXIDE BY GASEOUS DIFFUSION.

Russell A. Primrose; *Virginia Polytechnic Institute*

The diffusion was studied of carbon dioxide and hydrogen in equal proportions through barrier materials of fiber glass filter media at flow rates of 2, 4, and 10 cubic feet/hour and pressures of 2,5 and 10 psia. An 0.008-inch Dexiglas filter manufactured by Dexter and Sons gave 0.5% separation, while one 0.015-inch thick Vetra filter manufactured by Mine Safety Appliances gave 3%. A sintered stainless steel screen gave 3 to 4% with a pressure drop of 1.5 inches of water. Other filter media are being investigated.

13. THE DESIGN, CONSTRUCTION, AND OPERATION OF A HEAT EXCHANGER FOR A MOVING BED HYPERSORPTION PROCESS.

William A. Barkley and Stuart B. Row; *Virginia Polytechnic Institute*

Efficient heat exchange in the desorption heat exchanger of a moving bed hypersorption column has been difficult to obtain with standard heat exchangers. To evaluate the heat transfer characteristics of the activated carbon absorbent, a one-tube, vertical-tube heat exchanger was built. This heat exchanger had a length of three feet, a tube diameter of ⅞ inches, and a shell diameter of 2½ inches. The activated carbon flow rate was varied from 1.6 to 2.4 pounds per hour, and the steam pressure was varied from nine to 70 psig. The exchanger was also evaluated with and without agitation. From these experimental data, heat transfer coeficients, the maximum temperature of absorbent, and the optimum

operating conditions were obtained, Using the results obtained from the one-tube heat exchanger, a heat exchanger was designed and constructed for use in an experimental hypersorber. By evaluation of the variation of the steam pressure, agitation, and carbon flow rate, the optimum operating conditions of the heat exchanger were determined.

14. FUNDAMENTAL FACTORS AFFECTING MASS TRANSFER IN A MIXER-SETTLER TYPE EXTRACTION.

N. C. M. Landis, G. E. Brown and F. W. Bull;
Virginia Polytechnic Institute

A three stage mixer-settler liquid-liquid extraction unit arranged for countercurrent flow has been built for extractions using the system tolueneacetone-water. Each stage is composed of two sections of 2-inch diameter glass-pipe, 6 inches high, separated by an aluminum block. The two phases enter a stage through a copper tube nozzle in the aluminum block. intimate mixing occurs and centrifugal motion is imparted to the liquids. After mixing in the nozzle the two phases are allowed to settle by gravity and centrifugal action, and the light and heavy phases from each stage are removed from top and bottom of the stage. Two different nozzles (¼ and ⅜ inch) were used for rates of 120 and 200 pounds per hour total flow. Mass transfer coefficients and stage efficiencies have been calculated for the extraction of acetone from toluene with water using one, two, and three stages and both large and small nozzles; and for the extraction of acetone from water with toulene using one stage and a small nozzle. The necessary solvent to feed ratio for optimum transfer and stage eficiency has been determined.

15. THE EXTRACTION OF SODIUM HYDROXIDE AND ACETIC ACID FROM A SEMI-CHEMICAL PAPER PULP WASTE USING ELECTRODIALYSIS.

Nelson F. Murphy and Earl J. Holberg; *Virginia Polytechnic Institute*

The feasibility of electrolytically extracting sodium hydroxide and acetic acid from semi-chemical pulp black liquor using ion membranes was studied in a three-compartment cell having a steel cathode and platinum anode. Waste feed, dilute sodium hydroxide, and dilute acetic acid were introduced to the bottom of the central, cathode, and anode compartments respectively. Sodium ions passed into the cathode compartment through a 5-inch diameter Amberplex C-1 cation permeable membrane and acetate ions passed into the anode compartment through an Amberplex A-1 anion permeable membrane. Five tests conducted at about 360 ml. per hour anolyte feed rate and 60 ml. per hour catholyte rate were carried out in one to six hour periods with current varying from 0.772 to 1.00 amperes giving diaphragm current densities from 0.039 to 0.050 amperes per sq. in. The cathode diaphragm efficiency

rose from 18.3% to 89.5% for a six hour test, while the corresponding anode diaphram efficiency rose from 5.5% to 40.8%. The cell took more time with each test for the current to reach one ampere at 32 volts. The weight of the products extracted per killowatt-hour of power increased with the length of the test.

BUSINESS MEETING.

The business meeting of the section was called by the chairman at 4:00 p.m. on Friday, May 8. The nominating committee, N. F. Murphy, R. M. Hubbard and D. M. Crim, chairman proposed a slate of officers for the next year. Unanimously elected were O. R. Singleton, Jr., Chairman, Stuart B. Row, Secretary, and R. M. Hubbard, Editor. Four selected contestants from the Junior Academy of Science described their exhibits and answered questions of members. Mr. Eugene MacFarlane of Marian High School, Marian, Virginia was selected to receive the George Washington Engineering Award for 1959. The business meeting then adjourned.

16. GENERAL DESCRIPTION OF THE UNIVERSITY OF VIRGINIA NUCLEAR REACTOR.

Lawrence R. Quarles; *University of Virginia*

The University of Virginia has under construction a one megawatt swimming pool reactor which is scheduled to go critical next spring. The reactor facility is located near the western limits of the University and is readily accessible to all interested science departments. It will be operated by the School of Engineering but is designed for research use by the science departments and the Schools of Medicine and Engineering as well as for instruction in nuclear engineering. The divided pool offers a high degree of flexibility in use. The reactor may be positioned in either section of the pool for operation at approximately 100 kilowatts with convection cooling. Provision is made for forced cooling for operation at one megawatt with the reactor positioned at one end of the pool. Built-in facilities include two 8" beam holes, a 4' x 6' access port and a thermal colum. A large research area is provided at the top of the pool and another adjacent to the access ports. Plans call for eventual provision of radiation chemistry and hot laboratory facilities.

17. INHERENT SAFETY OF THE SWIMMING POOL TYPE NUCLEAR REACTOR.

J. L. Meem; *University of Virginia*

The key to the inherent safety of the swimming pool type reactor is in the use of ordinary water as a coolant and moderator. Neutrons produced by fission are high energy neutrons and must be slowed down to thermal energies before initiating additional fissions in the reactor. This process of slowing down neutrons is called moderation, and water is an

excellent moderator. If for some unknown reason, there is a sudden increase in power, the water is heated and becomes less dense, and this decreases the ability to slow down neutrons. Accordingly, the fission rate and reactor power decrease. This characteristic is called the "Negative Temperature Coefficient." All swimming pool type reactors have negative temperature coefficients and are inherently self stabilizing. An even more important characteristic of this type reactor is the "Negative Void Coefficient." An accident has never occurred in a swimming pool type reactor which initiated a power surge sufficient to cause boiling, but assuming such an accident did occur, it is easy to see that if sufficient heat were produced to cause boiling, the steam voids produced would greatly decrease the water density and shut down the reactor at once.

18. HAZARDS ANALYSIS FOR THE UNIVERSITY OF VIRGINIA NUCLEAR REACTOR.

Walter P. Walker; *University of Virginia*

This paper summarizes an evaluation of hazards which could result from an accident in a swimming pool-type research reactor. Each way in which radioactive contamination could be released and dispersed is considered, and for each an estimate is made of the radiation level to which off-site personnel might be exposed. Both probable and improbable (but conceivable) events are illustrated by numerical calculations for the University of Virginia reactor.

19. SHIELDING OF THE UNIVERSITY OF VIRGINIA NUCLEAR REACTOR.

W. Reed Johnson; *University of Virginia*

Shielding a nuclear reactor infers the protection of personnel and equipment from the effects of direct radiation from the reactor itself and its auxiliary systems. Although the University's swimming pool reactor is a comparatively simple type, it poses shielding problems analogous to those found in much more elaborate reactor plant designs. Gamma rays and fast neutrons are the important types of radiation the shield designer must consider. The first task is to specify the sources of radioactivity. These sources are, in general, the reactor itself, and the reactor cooling system. The latter is caused by neutron activation of the water coolant as it flows through the reactor core. Methods of calculation used in the shield design are those developed primarily by workers in the nuclear submarine field. The results of the shield calculation shows that the pool itself serves as a good shield for radiation from the reactor, while additional shielding in some areas is required to reduce the radiation from the coolant system.

20. HEAT TRANSFER IN THE UNIVERSITY OF VIRGINIA NUCLEAR REACTOR.

F. Anthony Iachetta; *University of Virginia*

This paper describes the core configuration of the University of Virginia Nuclear Reactor with relation to heat transfer to the coolant water. The core consists of twelve full fuel elements and four control rod elements arranged in a 4 x 4 matrix reflected by two outer rows of graphite elements. The coolant flow rate must be great enough to prevent local boiling at the hottest fuel element. Power density was assumed to vary as a sine function from zero at the core boundary to a maximum at the center 2.6 times the average. The heat transfer calculations were based on an inlet water temperature of 95°F. with the reactor producing an average power of 1 megawatt. The equations needed to predict bulk fluid temperature and fuel plate surface temperature were developed in terms of the appropriate physical properties of the system. The heat transfer coefficient for the fluid film was determined using Colburns equation for flow inside tubes. For various coolant flow rates, the maximum fuel plate surface temperatures were calculated and from these results, a pump capacity of 1,000 gpm was found to be satisfactory.

21. STUDY OF THE FISSION PRODUCT ACTIVITY IN THE GAS STREAM OF A GAS COOLED NUCLEAR REACTOR.

David D. Wallace; *University of Virginia*

This paper is a study of the activity of fission products entrained in the coolant stream of a helium cooled, high temperature reactor system using unclad fuel elements. The specific design examined is the Sanderson and Porter pebble bed reactor. The study is principally concerned with the effect of various purification rates on entrained and deposited fission product activity in the primary coolant system of this reactor type, and is purely theoretical. The fuel is assumed to be U-235. Those decay chains involving fission products which are volitile at core temperatures are examined, and the activity contribution of each such fission product is calculated, as is that of solid and liquid daughter isotopes which may be deposited in the system. These calculations are made for purification probabilities of 0,0,000,001, 0.000,01, 0.000,1, 0,001, 0.01 and 0.1.

22. AN ANALOG FOR THE STUDY OF TEMPERATURE CONTROL IN JACKETED CHEMICAL REACTION VESSELS.

William B. Cashion; *University of Virginia*

The thermal resistances of the various heat transfer surfaces in a packeted chemical reaction vessel play in important part in automatic temperature control. The effect of each resistance on controllability should

be known before reactor design is begun if satisfactory temperature control is to be obtained. A direct electrical analog can stimulate a reaction vessel quite well and can be used to study the effect of each thermal reistance on automatic control. Pneumatic control instruments can be used with the analog to eliminate the need of an operational analog computer which would be required to simulate them. The electrical resistance – capacitance network for simulating a reaction vessel was described along with the control system. Cascade control was selected because of its industrial popularity on this type application. The analog compares satisfactorily with experimental data on a 50 gallon reactor.

23. HEAT TRANSFER IN A HOT WATER STORAGE HEATER.

Robert M. Hubbard and Edward J. Leech; *University of Virginia*

Overall heat transfer coefficients were measured on a standard 475 gallon steam heated hot water storage heater. Steam pressure was 20 psi guage, water flow rates were 267, 307, 338 and 398 gal. per hour, and water pressure was varied from 5 to 60 psi gauge at each flow rate. With the highest water pressure, outlet water temperature varied from 193 to 218°F and at the lowest pressure it varied from 185 to 215°F. Overall heat transfer coefficients having maximum values from 190 to 210 Btu per hr per sq ft per °F decreased by 10 to 15% with increased water pressure. The higher heat transfer coefficients observed with low water pressure on the outside of the heating surface was explained by incipient boiling and greater water turbulence. The lower coefficients at higher water pressure were explained by the decreased turbulence in the water resulting from convection heat transfer with little or no bubble formation.

24. FACTORS INFLUENCING THE VOLUMETRIC HEAT TRANSFER COEFFICIENT IN A PARALLEL-FLOW SPRAY DRIER.

Everett L. Plyler; *University of Virginia*

A seven cubic foot spray drier was employed to assess esperimentally the influence of drier operating variables on the volumetric heat transfer coefficient. Atomization of the feed was accomplished by a two-fluid nozzle, and drying gases were introduced cocurrently with the spray. Aqueous sodium sulfate solutions were used for the investigation of feed rate, temperature level of drying gases, and average mass flow of gases. The influence of the nature of the material dried was studied using powdered milk suspensions, sodium chloride, and sodium sulfate solutions. A linear relation correlated satisfactorily the effect of feed rate on the volumetric heat transfer coefficient in the range 1.2 to 3.8 gal/hr. The volumetric heat transfer coefficient decreased as the average mass flow rate of drying gases was increased from 480 to 820 lbs./hr. A decrease

in this quantity also resulted as the inlet gas temperature was raised from 380 to 480°F. The results of three runs in which a powdered milk suspension, a sodium chloride, and a sodium sulfate solution were dried under similar operating conditions indicated little difference in the heat transfer coefficients for these materials.

25. SOLUBILITY AND LIQUID DENSITY OF CARBON DIOXIDE IN METHYLENE CHLORIDE AT 70° F. AT PRESSURES UP TO 300 PSIG.

Donald S. Buell and John W. Eldridge; *University of Virginia*

The methylene chloride – carbon dioxide system is of interest in the Aerosol Industry as a propellent mixture. This study was undertaken to extend the available liquid density and solubility data. Methylene chloride was degassed by distillation and transferred to an equilibrium cell under vacuum. Carbon dioxide was then charged under pressure. The cell was rocked in a constant temperature bath. Pressure readings were usually constant after fifteen minutes, and equilibrium was assumed after one hour. The equilibrium cell was designed so that a liquid sample could be isolated in a calibrated volume, disconnected, and weighed while under pressure to determine liquid densities. The sample was then analyzed by passing the vaporized liquid phase sample through a series of sodium hydroxide solutions to extract the carbon dioxide. The solutions were then titrated with standardized hydrochloric acid. Liquid density values ranged non-linearly between 1.322 gms./cm.^{3} at zero psig. and 1.222 gms/cm^3 at 300 psig. Agreement with the literature value of 1.324 gms./cm^3 at zero psig was good. Solubility values indicated a nearly linear relationship between zero and 300 psig. The carbon dioxide content was found to be 30.0 mole percent at 300 psig.

26. CATALYTIC STUDIES ON SURFACES OF SINGLE CRYSTALS OF NICKEL-COPPER ALLOYS.

Edwin Cox, Otis L. Updike, and Allan T. Gwathmey;
University of Virginia

An atom of nickel has two electrons in its 4s subshell but only eight 3d electrons. This gives nickel a pronounced "3d character." Copper has only one 4s electron but all ten 3d electrons, and therefore has no 3d character. Dowden and others have established a possible relation between 3d character and catalytic activity. Though copper and nickel have nearly the same atomic radius and alloy to form a simple solid solution in all proportions, investigators have reported a sharp change of physical and chemical properties in the region of 60-70 percent copper, where increasing copper content should cause a loss of 3d character. Effects of composition on catalytic activity are being investigated with single crystals of Cu-Ni alloys to study the relation of these effects to 3d

character. The reaction employed is:

$$2CO \xrightarrow{Ni/Cu} C + CO_2$$

Catalytic activity is observed both by rate of formation of carbon and by rearrangement of the surface as viewed under the optical and the electron microscopes. Experimental problems have included irregular crystal growth and difficult surface preparation. Electron micrographs of the surfaces after reaction show unusual carbon patterns, but as yet no crystals as high as 60% Cu have been available.

GEOLOGY

BUSINESS MEETING

A total of over seventy-five attended the sessions of the Geology Section. A brief business meeting followed the discussion of the last paper. Upon the recommendation of the nominating committee the following officers were elected:

Chairman — J. L. Calver; *Vice-Chairman* — E. W. Ramsey; *Secretary* — R. S. Mitchell; *Section Editor* — B. W. Nelson; *Historian* — J. K. Roberts.

FIELD TRIP

The annual field trip, under the leadership of G. H. Espenshade and E. O. Gooch, took place Saturday, May 9. The major stops of this trip included a soapstone quarry and plant at Schuyler; the Arvonia-Buckingham Slate Company operation at Arvonia; and the Kyanite Mining Corporation mine at Willis Mountain. About twenty-five took part in the trip.

1. THE GROUND-WATER RESOURCES OF WESTERN ALBEMARLE COUNTY, VIRGINIA.

Whitman Cross, II; *University of Virginia*

This study is concerned with the factors affecting the yield of drilled wells in the western half of Albemarle County, Virginia. The relative importance of lithology, structure, residuum, and topography was analyzed from data collected on 300 well sites. The effect of topography was found to be the greatest single influence on well yields. This same conclusion was recently reached by studies in similar Piedmont areas of

Georgia, North Carolina, and Maryland. Because of more intense fracturing and a greater recharge area, the valleys and draws provide a larger yield per well than other topographic locations. Hills provide the lowest yield with 20 percent of the wells considered dry. Yields vary from less than 1 gpm to over 75 gpm, but average between 5 and 15 gpm. Well depths range from 60 feet to over 700 feet, but average between 100 and 150 feet. The depth of residuum is occasionally as great as 100 feet, but averages about 50 feet. A large majority of the wells receive water from fractures less than 100 feet deep. Well-logging with resistivity, self-potential, and gamma ray probes was carried out to determine if water-bearing fractures, indicated by well cuttings and drillers' logs, could be located with these geophysical methods. Although an insufficient number of wells have been logged to date, a definite relationship appears to exist between log curves and the reported fracture zones. Several localities within this area show excessive iron varying from 1-10 ppm. This excessive iron content may be attributed to associated basic rocks. Acidity, ranging from pH 6.0 – 7.0, is common.

2. GARNET DEPOSITS IN THE VIRGINIA PIEDMONT.

Claude W. Crist, Jr.; *University of Virginia*

The Virginia Piedmont is composed of igneous, sedimentary, and metamorphic rocks. The metamorphic rocks are the result of regional metamorphism and often contain garnet. The writer has collected samples from outcrops containing garnet at various points over the Piedmont. These samples were studied under the polarizing microscope in the geology laboratories at the University of Virginia. This study brought out the following facts: (1) Garnet formed during regional metamorphism of peltic sediments of the Virginia Piedmont is found only in Precambrian rocks; (2) Only one locality in Virginia contains unusually large garnets; (3) The amphibole, cummingtonite, was found to occur with garnet at several localities. Cummingtonite has not been reported in Virginia before; (4) Crystal forms in pegmatites are usually tetragonal trisoctahedrons while those in metamorphic rocks are dodecahedrons. Garnet was found to occur in the following rock types: Schist, quartzite, gneiss, phyllite, and granite. The minerals which occur most frequently with garnet in these rocks are: Quartz, magnetite, limonite, biosite, muscovite, chlorite, zircon, sericite, plagioclase (albite), graphite, cummingtonite, staurolite, kyanite (?), apatite, and epidote. Several new garnet localities were found during this study. Two unsuccessful attempts have been made to mine garnet in Virginia in the past.

3. A DISCUSSION OF IRON OXIDE PSEUDOMORPHS AFTER PYRITE METACRYSTS IN THE PIEDMONT SCHISTS OF VIRGINIA.

Robert K. Peare; *University of Virginia*

This paper is concerned with the petrology and mineralogy of pseudomorphs of iron oxide after pyrite metacrysts from the Lynchburg formation of Virginia. The area from which the pseudomorphs were collected is approximately 120 miles long, extending from Jeffersonton in Culpeper County, southwestward to the Roanoke River between Bedford and Franklin counties. Over four thousand pseudomorphs were collected from 23 localities. About 13% of the specimens were found to be magnetic and displayed magnetic polarity. Two hundred specimens were studied in polished section and the mineral constituents were checked by x-ray diffraction. Pyrite, goethite, hematite, and magnotite were found, as well as minor amounts of quartz and sericite. Pyrite, containing incorporated sericite and euhedral magnetite, was the original mineral. Goethite replaces the pyrite, and hematite along with finely disseminated magentite replace the goethite. Hematite is never found in direct contact with the pyrite. The replacement has taken place along the [001] and occasionally along the [111] cleavage directions of the original pyrite. Textural features indicate that the replacement occurred under supergene conditions.

4. THE GEOLOGY OF THE PIEDMONT PHYSIOGRAPHIC PROVINCES OF VIRGINIA AS APPLIED TO HIGHWAY ENGINEERING.

W. T. Parrott; *Virginia Department of Highways*

The geology of the Piedmont of Virginia lends itself to a series of paradoxes insofar as highway engineering is concerned. From a wealth of aggregate for highway uses in the Triassis areas of the northern part, it passes into famine conditions in the southern part; its soil varies from loamy soil of the south to the extremely plastic clays of the north. Injurious minerals render some types of aggregate unfit for highway uses, while others form so strong an acid in the streams that only concrete structures will resist its corrosive action, The general geology of the Piedmont was discussed as well as some of the problems of highway engineering and construction.

5. HIGHWAY ENGINEERING IN VIRGINIA PHOTOGRAMMETRIC METHODS.

F. B. Bales; *Virginia Department of Highways*

The engineering and construction of the Interstate Highway System is advancing in Virginia through the use of Aerial Photography and Photogrammetry. Through photo interpretation and topographic mapping by aerial methods, the Engineer is able to select a highway location from the standpoint of soil, geology, drainage, and excavation; thus avoiding areas containing unsuitable materials, sinkholes, potential slide or mass movement areas, areas subject to frost heaving, caving, areas subject to flooding, areas of erosion and at the same time providing a facility which

will best serve the traffic demand. An Aerial Survey Section adequately staffed and completely equipped, including a complete Photographic Laboratory, has been established within the Virginia Department of Highways for the purpose of meeting the aerial photography and photogrammetric mapping requirements of the Department.

6. SOME METAMORPHIC FEATURES OF THE PRECAMBRIAN ROCKS OF THE SOUTHERN BLACK HILLS, SOUTH DAKOTA.

J. A. Redden; *Virginia Polytechnic Institute*

The metamorphic rocks of the southern Black Hills are largely medium-to high-grade schists containing some units of quartzite, metairon formation, and other rock types. There are few differences in the mineral assemblages of most of the rock units above and below the sillimanite isograd. Sillimanite appears first in moderately aluminous quartzose beds and is not found in some highly aluminous rocks, apparently because a high content of ferromagnesian constituents in the latter tended to tie up the aluminum in garnet, staurolite, and cordierite, and, delay or prohibit the appearance of sillimanite. The area has experienced at least two peaks of metamorphism. An early episode of regional metamorphism has been modified by later more nearly thermal metamorphism. The latter is apparently associated with the emplacement of considerable granite and pegmatite. The outer limit of the pegmatite distribution coincides locally with the sillimanite isograd.

7. THE DORE LAKE COMPLEX: A METAMORPHOSED LAYERED COMPLEX (CHIBOUGAMAU DISTRICT, QUEBEC.)

Gilles O. Allard; *University of Virginia*

The Dore Lake Complex is a stratiform sheet similar to the Bushveld, Stillwater, and Duluth Complexes, but differs from those by the predominance of anorthosite and anorthositic gabbro and also by the regional metamorphism (greenschist facies) which has produced some unique and rare rock types. The Dore Lake Complex is located in the Chibougamau mining district, Province of Quebec, Canada, 320 miles north of Montreal. It introduces Keewatin-type volcanic rocks and originally had a flat sill-like shape but has been arched by a younger granitic batholith. The layered complex is 27 miles long and approximately 10,000 feet thick. Anorthosite and gabbroic anorthosite formed the main layer of the mass. It is now metaanorthosite, a mixture of albite, zoisite and/or clinozzoisite, and chlorite. Small patches of unmetamorphosed anorthosite indicate a very calcic plagioclase (An80). The metaanorthosite grades into a transition zone (gabbroic metaanorthosite and anorthositic metagabbro) which is overlain by magnetite-rich metapyroxenite, metapyroxenite, serpentinized dunite and/or serpentinized peridotite. This in turn is inter-

banded and overlain by metagabbro, different types of diorites, and granophyre. Layering, foliation, and banding is present throughout but difficult to observe in the very coarse anorthosite layer. The area is transected by 3 sets of fractures. The southeast-trending shears are commonly mineralized and copper ore is mined or explored along 9 of those zones. All the orebodies located so far are in the anorthosite-gabbroic anorthosite member of the Dore Lake Complex.

8. PRELIMINARY REPORT ON THE GEOLOGIC INVESTIGATION OF THE ROSELAND ANORTHOSITE AND ASSOCIATED TITANIUM DEPOSITS.

Neil Hillhouse; *Virginia Polytechnic Institute*

The Roseland anorthosite body, an intrusive mass composed chiefly of oligoclase with some andesine, underlies an area of approximately 25 square miles in Amherst and Nelson Counties, Virginia. It is intrusive into the Lovingston gneiss, a complex of meta-igneous rocks, now chiefly biotite-feldspar augen gneiss of quartz-monzonitic composition with a few inclusions of meta-sedimentary rocks and some fine-grained schists. The contact between the massive anorthosite and the gneiss is gradational over most of the region. In many places, the "border facies" consists of contaminated anorthosite producing a highly feldspathic gneiss. Much of the border region is marked by small, possibly later, intrusions of granite-textured rocks ranging in composition from diorite to granodiorite. Titanium deposits in the form of ilmenite-apatite bodies (nelsonite dikes) are localized near the anorthosite-gneiss contact. Titanium also occurs as rutile in the anorthosite, as ilmenite disseminated in the gneiss and granitic rocks, and as ilmenite in magentite bodies in the gneiss. The iron to titanium ratio increases, therefore, with distance from the center of the anorthosite, indicating that introduction of Titanium accompanied intrusion and that the iron in the ilmenite deposits was supplied by the country rocks. It is believed, however that the upper and outer parts of the anorthosite mass had solidified and been sheared before mineralization by titanium-bearing, fluorine-rich fluids from the core of the mass.

9. MINERAL INDICATORS OF ENVIRONMENT IN SEDIMENTS OF PART OF THE MARYLAND COASTAL PLAIN.

Dorothy Carroll; *U. S. Geological Survey*

The basal beds of Early Cretaceous age (Potomac group) consists of gravels, sands, and clays derived from the weathering of Piedmont rocks. These materials were deposited in swamps and lakes. The clays carried iron oxides that in the reducing environment of the swamps and lakes. The clays carried iron oxides that in the reducing environment of the swamps provided the iron for the crystallization of pyrite and siderite. The presence of these minerals indicates the redox potential of the deposition basins. Kaolinite is the principal clay mineral. Mixtures of kaolinite

and water (1 to 5) have pH values of 5 to 6 which suggests a low pH during and after deposition. The detrital heavy minerals include angular and corroded staurolite, garnet, and tourmaline. Both staurolite and garnet have crystal structures in which ferrous iron can be attacked by solutions. The corrosion of these minerals is thought to be due to the low pH and Eh conditions of the environment, and is an expression of the diagenetic changes in the minerals. Acid clay in this environment is an active chemical weathering agent and detrital minerals in contact with it are corroded. The low Eh helps to keep any iron removed in solution.

10. MONOCRYSTALLINE SPELEOTHEMS.

James F. Quinlan, Jr.; *Virginia Polytechnic Institute*

The following observations have been made: 1) Monocrystalline speleothems consist of calcite. 2) All the cleavage planes of a monocrystalline speleothem are those of a typical calcite rhomb whose optical c-axis coincides with the long axis (axis of growth) of the speleothem. 3) The tip of most monocrystalline speleothems is triangular. 4) Externally monocrystalline speleothems may have 3, 4, 5, 6, 8, or 12 sides, not all of which are necessarily equally developed. 5) Some monocrystalline speleothems consist of a monocrystalline core that is covered by a sheath of either radially deposited calcite or concentricly deposited calcite, clay, and perhaps aragonite. In some specimens this is due to precipitation within the central tube. In a few other specimens it appears that there never was a central tube as such. 6) The central tube of some externally monocrystalline stalactites has a rhombic cross-section rather than a typical round cross-section. 7) Some apparently monocrystalline stalagmites exhibit a radically mozaic texture in thin section. 8) Some stalactites have been found to consist of a twinned calcite crystal. 9) Some monocrystalline stalactites cleave in a plane which has six small saddles that occur at the periphery of the stalactite and give it a stellate appearance. In thin section these saddle-shapped areas are characterized by off center optic axis figures. The conditions that determine the occurrence of monocrystalline speleothems instead of the development of the more typical forms are not known. Probably the development of monocrystalline speleothems is directly influenced by: 1) presence or lack of chemical impurities, 2) lack of contaminating clay, 3) drip rate of calcium bicarbonate solution, 4) rate of precipitation, 5) temperature.

11. THE AGE AND THE FAUNA OF THE HUNTERSVILLE FORMATION.

Philip S. Ciaramella, Jr.; *Virginia Polytechnic Institute*

Several good Huntersville-Tannersville area, Tazewell county, exposures are located on the southeast limb of a large plunging anticline that has been dissected by erosion. The formation, consisting of chert, sand-

stone, and limestone, is approximately 120 feet thick. An unusual well preserved fauna contains corals, crinoids, bryozoans, brachiopods, pelecypods, and ostracodes. Among these there are several new species and one genus of brachiopod. Most of the identifications are restricted to the generic level. Several of the specific identifications made relate species to those found in the Devonian of New York. On the basis of the brachiopds the formation is upper Oriskany, Esopus, Schoharie, and Onondaga in age. The occurrence of the brachiopod *Spirifer macrus* Hall suggests that beds of the same age as the Moorehouse member of the Onondaga are present. The youngest member of the Onondaga, the Seneca, may or may not be represented.

12. CELESTITE AND STRONTIANITE FROM WISE COUNTY, VIRGINIA.

R. F. Pharr and R. S. Mitchell; *University of Virginia*

Celestite and strontianite are found in vugs in dolomite of the Cayuga group (Silurian) in a quarry about one-half mile east of East Stone Gap, Wise County, Virginia. Most of the celestite crystals are elongated parallel to the *a* axis, and the (011) faces predominate. Other important faces observed are (101), (100), (210), (001), (211), (122). In all cases (100) is deepely striated and (011) is badly etched. A few tabular crystals, flattended parallel to (001) were observed. Other forms on these tabular crystals are (101), (011), (100), (210), and (111). The stronianite occurs as globular masses which vary in size from very small to a half inch in diameter. The globules have a radical structure and are vitreous to dull. Usually the strontianite is intimately associated with badly etched celestite, which suggests that it was formed by the reaction of weak carbonic acid waters upon the sulfate. A semiquantitative spectrographic analysis shows that 15% CaO is contained in this mineral, making the material *calciostrontianite*. X-ray diffraction values also show a significant chemical departure from pure strontium carbonate. Small amounts of yellow-brown sphalerite are at times closely associated with the strontium minerals. Colorless and honey-yellow calcite scalenohedrons, apparently not intimately associated with celestite and strontianite, were also collected in the quarry. Some excellent scalenohedrons twinned on (0001) were noted.

13. DESCRIPTION OF THE CONCRETIONS FROM THE MILLBORO BLACK SHALES.

Clarence E. Roberts and George T. Farmer, Jr.; *University of Virginia*

Millboro concretions were collected from a zone extending from Pendletion County, West Virginia to approximately one mile northeast of Clifton Forge, Virginia. The concretions have been found to range from about 3/8 of an inch parallel to the long axis and 1/4 of an inch in

thickness, to eight feet parallel to the long axis and one foot in thickness. Generally, they are flattened with their long axis parallel to the bedding of the surrounding strata. Secondary zones of calcite and barite may be seen filling the joints in many of the specimens. Externally, three distinct types of concretions are noted: (1) those that have a smooth exterior; (2) those with a rather rough exterior containing indications of bedding; and (3) those containing radial fiberous barite crystals forming the exterior margin. Internally, the first type consists of a dense black calcareous matrix with uniformly fine-grained crystals of pyrite concentrated near the outer margin. The second type contains large unoriented barite crystals and pyrite is occasionally embedded in the barite and concentrated in zones parallel to the bedding. The third type usually shows good zoning. The outer portion is composed of a uniformly fine-grained matrix usually containing euhedral crystals of pyrite and barite. The interior zone commonly shows a concentration of euhedral pyrite and radiating barite septarian structures. Septarian structures are always associated with the concretions which contain radial fiberous barite crystals along the outer margin.

14. BASAL CONGLOMERATE IN MOSHEIM LIMESTONE IN RICH VALLEY, SMYTH COUNTY, VIRGINIA.

Fred Webb, Jr.; *Virginia Polytechnic Institute*

The Mosheim limestone of early Middle Ordovician age disconformably overlies the Knox dolomite of late Early Ordovician age. The surface of disconformity is the result of erosion of the Knox prior to the deposition of the Mosheim, evidenced by the presence of breccias and conglomerates of Knox-derived dolomite and chert in the Mosheim limestone. The breccia and conglomerate are usually best developed at the base of the Mosheim. Inliers of Knox dolomite surrounded by Mosheim are common and the largest one attains an area of about 1.5 acres. The maximum relief developed on the surface of erosion in this area is about 460 feet. The disconformity is evidence that the Knox was above sea level during part of post-Early Ordovician, pre-Middle Ordovician time. A eustatic change in sea level was probably responsible for the erosion as the missing interval is bounded by the uppermost Lower Ordovician and the lower-most Middle Ordovician known in the southern Appalachian region.

15. FAULTS AND FAULT BRECCIAS OF THE BLACKSBURG-SHAWSVILLE AREA.

John B. Deaton; *Virginia Polytechnic Institute*

Three major thrust faults are present in the Blacksburg-Shawsville area in southeastern Montgomery County, Virginia. The Shawsville and Max Meadows faults are considered to be low angle thrusts. The Salem

fault is a relatively high angle thrust. The Shawsville fault extends southwestward from the vicinity of Shawsville on U. S. Route 11 through the town of Christiansburg. A branch of this fault extends northward from Christiansburg through Blacksburg, and probably joints the main Pulaski fault trace to the northwest. The Shawsville fault may represent a branch of the Pulaski fault. The Max Meadows fault is also interpreted as a low angle thrust. Numerous Klippen occur on knobs and ridges northeast of the main fault trace. The Salem fault extends in a northeast-southwest direction parallel to the Shawsville fault and about two miles to the northwest. A thick zone of tectonic breccia, composed mostly of crushed dolomite and limestone, is associated with the Shawsville fault. A much thinner zone of breccia, thoroughly silicified, occurs along the Max Meadows fault. Relatively little deformations has occurred along the outcrop of the Salem fault. The Shawsville fault is cut north of Christiansburg by the Salem fault, indicating that the Salem fault is younger. In the vicinity of Shawsville, the Shawsville fault trace is covered by the Max Meadows fault block, suggesting that the Max Meadows fault also is younger than the Shawsville fault.

16. PRIMARY SEDIMENTARY FEATURES IN THE UPPER MISSISSIPPIAN OF MERCER COUNTY, WEST VIRGINIA, AND GILES COUNTY, VIRGINIA.

William Andrew Thomas; *Virginia Polytechnic Institute*

The Upper Mississippian clastic sequences in the Mercer-Giles county area are divided into four formations: in ascending order — Bluefield formation (1000 feet), Hinton formation (1200 feet), Princeton conglomerate (30 feet), and Bluestone formation (700 feet). The formations are exposed on both flanks of the overturned Hurrican Ridge syncline. Penecontemporaneous slump structures occur in the upper Hinton and lower Bluestone formations in a heterogeneous sequence of maroon-drab mudstones, gray clay shales, maroon fine-grained sandstones, light-brown medium-grained sandstones, and argillaceous limestones. Small flow casts on the under surfaces of some sandstone beds which rest on mudstones demonstrate the importance of differential compaction in soft sediments. At Athens, Mercer County, a local body of limestone is warped into an asymmetric syncline, which is truncated by a massive standstone and limestone-pebble conglomerate. The total stratigraphic interval involved is less than 40 feet. In a sandstone lens near Bluefield, Mercer County, the individual beds are highly deformed and disordances in dip of up to 70° are noted. Deformation of these units is attributed to differential compaction and slumping of underlying materials. On the northwest flank of the Hurricane Ridge syncline local exposures of contorted bedding, limited to a few feet both stratigraphically and laterally, occur as mild undulations in otherwise undisturbed beds. A fault of few feet displacement is exposed in similar

setting near Rich Creek, Giles County. The origin of these structures is attributed to slumping and sliding of soft sediments into the trough of the syncline.

MEDICAL SCIENCES

1. EFFECT OF INSULIN ON GLUCOSE UTILIZATION BY FROG SKELETAL MUSCLE *in vitro*.

D. R. H. Gourley; *Department of Pharmacology, University of Virginia*

In contrast to its effect in rat muscle, insulin has never been found to influence glucose utilization in frog muscle when the experiment is performed at the usual temperature of 20°C. At 24°C, however, in the presence of 0.02M glucose, insulin increases the oxygen consumption of intact frog muscle by 27% and the final glycogen content of the muscle increases by 10%. The utilization of glucose increases by 104% when insulin is present. Qualitatively, therefore, there is no difference in the *in vitro* effects of insulin thus far studied in the skeletal muscle of the frog and rat.

2. THE PRODUCTION OF HEMORRHAGIC IRREVERSIBLE SHOCK IN THE CAT.

Eugene D. Brand; *Department of Pharmacology, University of Virginia*

An improved method for the production of irreversible shock in the cat consists in maintenance of hemorrhagic hypotension at 40 mm Hg for 5 hours followed by return of all of the animals blood. Some advantages of this procedure are: (1) no acute deaths during hemorrhagic hypotension; (2) artificial respiration not required; (3) uniform and consistent course of gradual failure of the blood pressure to death; and (4) duration of survival can be predicted from the amount of automatic reinfusion and the amount of hemoconcentration resulting from the period of hemorrhagic hypotension.

3. AN INTERSPECIFIC STUDY OF PER CENT FATNESS AND OF WATER CONTENT OF THE FAT-FREE BODY.

Grover C. Pitts; *Department of Psychology, University of Virginia*

This study was based on 116 wild mammals of 29 species and 13 families and was supplemented by recalculations of published data on 10 additional species. The range in gross body weight was 3 to 130,000,000 grams. Fatness was determined by petroleum ether extraction and body water by freeze-drying. Log body fatness (%) plotted against log fat-

free body weight (FFBW) yields a straight line with a positive slope. This suggests a power function. An analysis of this relationship in terms of the energetics of fat storgae and transport is presented. Evidence is presented that per cent water in the FFB is not constant from species to species as was previously assumed but is an inverse function of FFBW. It ranges approximately from 79% in the shrew to 71% in the steer. It is suggested that this range reflects a variation in fraction of low-water components present.

4. METABOLIC STUDIES ON FROG SKIN EPITHELIUM AND EPITHELIAL HOMOGENATE.

Leif Skjelkvale, Kathryn Nieder and Ernst G. Huf;
Medical College of Virginia

In spite of the frequent choice of frog skin in studies on active ion transport there is a great paucity of knowledge about metabolic pathways in skin epithelium. To fill the gap, work was begun on intact epithelium and homogenates. A simple method will be described whereby epithelium can completely be removed from the corium. Comparative data will be presented on mineral composition and O_2 uptake of epithelium and whole skin. O_2 uptake of epithelium suspended in Ringer's was measured in the absence and presence of metabolites, inhibitors, competitors. Unexpected difficulties were encountered in the preparation of epithelial homogenates,. Stable homogenates can be prepared, however, in isotonic KCl. Such preparations have a very low O_2 uptake unless the medium contains as essential factors: metabolites (e.g. pyruvate and furmarate), Mg, ATP, TPP, cytochrome C, liver concentrate. The influence of pH, Ca, Mn, thioctic acid was also studied. Epithelial homogenates contain a factor which strongly inhibits the respiration of kidney homogenates and, most likely, depresses the respiration of epithelial homogenate itself.

5. URINARY BLADDER RESPONSE IN THE CAT TO STIMULATION OF THE THALAMUS, HYPOTHALAMUS, BASAL GANGLIA AND OTHER FOREBRAIN STRUCTURES.

Everett H. Ingersoll, Louise L. Jones and Erling S. Hegre;
Department of Anatomy, Medical College of Virginia

The response usually obtained was characterized by a sustained diminution in the volume of the vesicle which generally could be abolished by section of the pelvic nerves. Occasionally stimulation elicited an immediate contraction of the bladder musculature which was followed in a few seconds by a prolonged relaxation. Again this response was abolished usually by section of the pelvic nerves. In other cats, inhibition of rhythm together with increased volume was evoked by stimulation. Such responses could usually be abolished either by section of the pelvic nerves

or by changing the frequency of the stimulus. This investigation was supported in part by research grant B-704 from the National Institute of Neurological Diseases and Blindness.

6. EFFECT OF EXPOSURE TO COLD ON THE RESPONSE TO ALCOHOL INTOXICATION OF RATS WHICH ARE DEFICIENT IN TRYPTOPHAN AND NIACIN.

J. C. Forbes and G. M. Duncan; *Medical College of Virginia*

We have reported that rats in which a niacin deficiency was induced by feeding a diet lacking both tryptophan and niacin, showed diminished adrenal response to alcohol intoxication. We now report that rats with this deficiency showed decreased resistance to alcohol after exposure to cold (2-5°C) for 3 days. One-third of the deficient animals died from 1-6 hours after alcohol while no deaths occurred in pair-fed controls under the same conditions. The rate at which alcohol disappeared from the blood was also definitely less in the deficient rats than in controls, in the cold or at room temperature. Exposure to cold caused an increase in the rate of alcohol clearance from the blood in all animals; this was marked only in the pair-fed controls. Exposure to cold for 3 days also depleted the already low liver glycogen of the deficient rats but after 7 days in the cold there was a return toward the original values. Alcohol given to deficient and control animals caused a drop in the liver glycogen at room temperature as well as in the cold.

7. A STUDY OF THE DEVELOPMENT OF THE SACROCOCCYGEAL REGION OF HUMAN EMBRYOS AND FETUSES.

James E. Kindred; *School of Medicine, University of Virginia*

The object of this investigation is to record the types of tissues and organs which develop in the sacrococcygeal region of the human embryo during fetal life. Thus fifteen young human embryos from 2 to 15 mm. in length have been studied by reconstruction from sections; and the sacrococcygeal region from 20 fetuses from 20 mm. to 250 mm. (CR) long have been studied directly in parasagittal sections. The kinds of tissues present, their waxing and waning, their mitotic activity and their fate have been recorded as far as possible in semi-quantitative fashion.

8. HYPOTHERMIA IN THYROIDECTOMIZED RATS.

Chalmers L. Gemmill; *Department of Pharmacology, University of Virginia*

The work on hypothermia in rats has been continued by measuring body temperatures and pulse rates at an ambient temperature of 9°C. Under pentobarbital sodium anesthesia, the response is related to body size. The smaller rats have a progressive fall in body temperature and pulse rates while the larger rats maintain their temperatures around 30°C

for two to three hours after the primary fall. Later, there is a secondary fall although a few rats have had a recovery from the 30°C level. Thyroidectomized rats, regardless of size, have only a progressive fall in temperature and pulse rates from the start of the experiment. Rats on 3,3',5-triiodothyronine have a moderate fall in temperature and pulse rates and a more rapid recovery when compared to the normal and thyroidectomized rats.

9. EXPERIMENTALLY PRODUCED REGENERATION OF ADULT FROG LIMBS.

Theodore I. Malinin; *Department of Pathology, University of Virginia*

Limb regeneration does not occur in adult anurans under ordinary circumstances. However, it was demonstrated that regeneration can be brought about by implantation of embryonic and young tadpole tissues into adult anuran limbs several days prior to their amputation. Heat killed larval tissues were also capable of promoting regeneration, while agar implants prevented normal healing and eventually produced foreign-body granulomas. About one hundred and eighty animals were used in these experiments. The regenerating limbs were examined histologically at various intervals. It became apparent from these observations that live implants are capable of survival in the host for long periods of time, that they do not cause foreign-body reactions, and that some of these contribute cells to the regenerates. However, these cellular contributions are not essential for initiating regeneration since heat killed implants are also capable of promoting regeneration. It is concluded that some physiologically active substances are produced by the implants and that these substances act to produce regeneration.

10. CLINICAL AND EXPERIMENTAL STUDIES ON NEPHROSIS.

Cornelia Hoch-Ligeti; *School of Medicine, University of Virginia*

It was found that nephrotic children with high serum lipoproteins excrete no lipoprotein in the urine although all protein fractions could be demonstrated. This observation was confirmed with rats rendered nephrotic by injections of aminonucleoside. In rats the sequence of changes in several enzymatic reactions, morphological changes, and fat deposition in the kidney, were related to the occurence of albuminuria, ascites and changes of protein and lipoprotein distribution in serum and in urine. It is suggested that the lipid is split off from the protein in the kidney with both components being excreted separately.

11. X-IRRADIATION OF RAT CENTRAL NERVOUS SYSTEM.

Robert H. Brownson; *Department of Anatomy, University of Virginia*

It is the design of this experiment to analyze in some detail, the neurocytological, neurohistochemical and behavioral reactions in acute

and chronic stages following exposure to x-irradiation. Approximately 120 male rate 9 months of age were divided into acute, chronic and control groups. Exposures were made at the rate of 250/r/minute until each animal had received a total head irradiation of 1000r at weekly intervals. Irradiation was continued each week until such cumulative totals had reached 5000r. Glycogen, methyl green pyronin, phospholipids and lipid histochemical studies were employed in conjunction with Weil, Nissl, azocarmine and Marchi cytological methods. Chronic animals whose post-irradiation time is in terms of months and years are being tested psychologically for behavioral changes. In addition to the behavioral studies, tissues are examined by methods identical to those utilized in the acute phase of this study. Electroencephalogram 4-channel recordings and chemical analysis for total brain lipids have been collected on representative samples from each of the acute levels of x-irradiated animals and is currently being examined.

12. OVARIAN PREGNANCY.

Bernard A. Heckman and Delilah A. Little (Introduced by James E. Kindred); *School of Medicine, University of Virginia*

Ovarian pregnancy is quite rare. The specimen to be described was obtained from the Department of Pathology to which it had been sent for confirmation of diagnosis. When we received the specimen it had been sectioned so that only parts of the 8 mm. fetus remained. The chorion covered with many villi was embedded in the ovary. There was a large chronic cavity in which floated a piece of the embryo. Sections through the wall of the wall of the chorion showed that it had burrowed into the ovary and become attached in the region of the corpus luteum of pregnancy. The pregnancy was apparently of secondary rather than primary origin, that is, the ovum had developed to a certain degree in the uterine tube, been discharged through the abdominal os, and become secondarily attached to the ovary. It does not appear to have arisen from an ovum fertilized in the ovary.

13. ANOMALIES OF THE UMBILICAL CORD IN HUMAN EMBRYOS AND FETUSES.

Burton D. Goodwin and William M. Runkle (Introduced by James E. Kindred); *School of Medicine, University of Virginia*

The anomalous umbilical cords described here are those which have been collected by the Department of Anatomy from specimens sent to us by the Departments of Obstetrics and of Pathology. Some of the simple forms of knots and foldings are said not to be harmful to the fetus unless drawn tight to close off the intrauterine circulation. Another kind of tight entanglement around the neck has resulted in the contraction of

the neck to such a degree that the head has lost its characteristic features. In a 15mm. embryo an umbilical cord has fused with the sacral region of the body and wrapped itself around the body in such a way as to form a sac enclosing the hind limb-buds. The mesoderm of the body and of the cord are continuous. This condition is accompanied by rachischisis and malformations of the more cephalic parts of the body.

14. HUMAN MONSTER WITH ABNORMAL DEVELOPMENT OF THE AMNION.

David S. O'Brien and Charles L. Gaudry, Jr., (Introduced by James E. Kindred); *School of Medicine, University of Virginia*

This report is a description of a human term female monster in which faulty development of the amnion damaged extensively the anterior surface of the head and body. The fusion started with the face which is disfigured by the invasion of the amnion around the nose and down into the throat. The amnion emerges from the throat and passes across the chin to become fastened to the body wall in such a way as to interfere with the normal development of the sternum and heart. Below this the body appears to be normal as far as the umbilicus, but below this there is a large hernia thru which the liver and intestine project. This is one of the few anomalous conditions in which the amnion is involved to a fatal degree.

15. DESCRIPTION OF FULL TERM MALE "SIAMESE" TWINS OF THE THORACOPAGUS TYPE.

James H. Carroway (Introduced by James E. Kindred); *School of Medicine, University of Virginia*

These twins are joined at their ventro-lateral surfaces by a broad band of body wall containing the heart and liver, large arteries and veins. The larger twin is 279 mm. and the smaller 255 mm. long (CR). The total weight at birth was 9 lbs. 6 oz. The head of the larger twin looks normal, but that of the smaller seems to be deformed. The umblilical cords are joined at the umbilicus and a common umbilical vein enters the single median liver. The heart is broad and there is a systemic trunk for each twin. There is a common large broad atrium into which all of the veins empty. The duplicated viscera are mirror images of each other. Further details are to be presented after dissection.

16. DISSECTION OF A HUMAN CRANIOPAGUS PARIETALIS.

Robert B. Moore and Arthur H. Wasser (Introduced by James E. Kindred); *School of Medicine, University of Virginia*

Basic information concerning the anatomical relations between skin, meninges, vascular and nervous systems of twins joined by their crania

is not extensive. The female twins described here are joined by the tops of their heads and one faces in the opposite direction from the other. One body is 300 mm. and the other 320 mm. long. Their heads are joined broadly and the dissection will describe the conditions at the junction. Apparently the other parts of the body are normal.

17. DESCRIPTION OF A HUMAN FULL-TERM CYCLOPS.

Louis J. Elsas and John T. Hutchens (Introduced by James E. Kindred); *School of Medicine, University of Virginia*

This specimen is characterized by a single abnormally developed eye in the center of a low forehead. Knobs of flesh are present in place of external ears. There is no nose and the mouth appears to be normal. In preliminary dissection it was found that the head had hydroencephaly, a condition in which fluid in the meninges has compressed the cerebrum and prevented its normal development. There seems to be two optic nerves going to a fused eye. The brain stem appears to be normal. Viscera are grossly normal morphologically. Histologic studies and more dissections are being carried on.

18. ANOMALIES OF KIDNEYS OF HUMAN EMBRYOS AND FETUSES.

Edwin L. Lyons, Robert K. Maddock, Jr. and Alan D. Rosenthal (Introduced by James E. Kindred); *School of Medicine, University of Virginia*

This report concerns the cytologic and morphologic relations of several varieties of metanephric malformations which have been found in the human embryos and fetuses in the collections of the Departments of Anatomy and of Pathology. The descriptions are of the following conditions: (a) horseshoe kidney in a 12 mm. embryo; (b) double kidney and double ureter in a 75 mm. fetus; (c) agenesis of secretory part of kidney and hypotrophic ureter; and (d) cystic kidney from biopsy of child.

19. ABSORPTION, DISTRIBUTION, AND EXCRETION OF METHOCARBAMOL.

Leah L. Eubank, Frances K. Coles, Addison D. Campbell and Ernst G. Huf; *Medical College of Virginia*

Absorption, distribution and excretion of methocarbamol were studied in normal and pregnant dogs and total urinary excretion of methocarbamol in man was investigated. In acute experiments on anesthetized animals, the dogs received C^{14} labeled drug or unlabeled material into a loop of the small intestine. Methocarbamol distributes itself throughout the body and, when given in a relatively large dose, is found in tissues in concentrations higher than expected upon the basis of simple diffusion equilibrium between blood and tissue fluid. Lipoid from several tissues contained less methocarbamol than the residue of those tissues. At best,

84% of the administered dose could be recovered from urine, bile, blood and the main soft tissues. In chronic experiments dogs received methocarbamol orally, daily, for two weeks. Then the drug was withdrawn. Less than 1% of the total administered dose was found in the chief soft tissues one day or a few weeks after withdrawal of the drug. When a single dose of C^{14} methocarbamol was given orally to doges, it was found that 50 to 90% of the activity appeared in the urine, and 10 to 12% in the feces on the first day. Only small amounts of C^{14} active materials appeared later in the urine and feces or remained in the tissues. In 2 out of 4 dogs so treated, all C^{14} activity administered to the dogs was recovered in urine, feces and tissues, the latter contributing not more than about 2% to the total. Methocarbamol permeates across the placenta into the fetus. It was found in amniotic fluid, cord blood, blood and several organs of the puppies; and it also appeared in the bitch's milk. Two human volunteers ingested methocarbamol for three consecutive days. Quantitative urine collections were made. The urine was analyzed for methocarbamol before and after acid hydrolysis. Less than 1% of the drug given appeared in the urine in free form. After hydrolysis about 10% could be recovered. Similar data were obtained in studies on dogs.

PSYCHOLOGY

1. PAINLESS ELECTRICAL CUTANEOUS STIMULATION.

Robert H. Gibson; *University of Virginia*

Arousal of cutaneous sensations by electrical stimulation of the skin is frequently accompanied by pain. The value of such stimulation, both for research and for communication purposes, would be enhanced were pain eliminated. The present investigation seeks to determine some relevant conditions for painless cutaneous electric stimulation. Single, suprathreshold envelopes of alternating current have been presented to several body loci. Two frequencies, two sizes of active electrode, and several envelope durations have been independently manipulated, using the subject's report as an indication of pain. At some body loci, higher frequencies were reported as painless.

2. SHORT TERM MEMORY IN A SEQUENTIAL TASK.

John B. Feallock; *University of Virginia*

The task studied is one in which stimuli are presented sequentially to a subject and he must recall them when they are asked for, one at a time. Since the presentation and recall of any given stimulus may be

separated by the presentation or recall of other stimuli, it is sometimes necessary for the subject to remember several stimuli while he is recalling one of them. In the present study the average number of stimuli that must be remembered at recall occasions defines the concept of "average storage load." Average storage load was manipulated as an independent variable, and its effects upon performance were assessed in terms of recall scores. It was predicted that recall errors would increase with average storage load. Analysis of errors scores indicated that both average storage load and subjects were significant variables of performance. As predicted, error scores increased systematically with average storage load.

3. THE INTERTRIAL INTERVAL IN AVOIDANCE CONDITIONING.

Raymond H. Kirby; *College of William and Mary*

Four groups of ten rats each were given 51 instrumental avoidance conditioning trials in a shuttle-box. The CS was a buzzer and the US was electric shock. Two groups were trained under intertrial intervals of 15 to 60 seconds respectively. Two other groups had five minutes and thirty minutes rest intervals interpolated after every fifth trial. A pseudoconditioning control group of ten rats was matched to the 60 second group. It was found that a 30 minute-rest interval reliably decreased avoidance responding below the 60 and 300 second-rest groups. Intertrial interval had no reliable effect.

4. PARTIAL RECOGNITION, WORD FREQUENCY, AND RESPONSE BIAS.

William Forrest Hawkins; *University of Virginia*

Does increasing the frequency of a word lower recognition thresholds? Recent studies have sugested that the word-frequency – recognition threshold relationship may bear no relation to perception. This study investigated the role that perception does play in recognition experiments, and focused on partial recognition. Nonsense syllables were divided into three families of seven words, each family having the same mid-letter. Frequency of training was varied in each family. In a recognition session, different visual presentations were used. For one group of Ss, and, for the third group, the total word was presented. The previously reported relationship between word-frequency and frequency of response was supported. The part that perception played seemed to be one of reducing response alternatives.

5. ATTITUDES OF PARENTS AND EDUCATORS TOWARD SEX EDUCATION IN PUBLIC SCHOOLS.

Cyril R. Mill; *Department of Mental Hygiene and Hospitals*

Several years ago the State Department of Education removed

from the approved list a variety of texts, films, film-strips, and pamphlets relating to human reproduction, dating, marriage and family life. This investigation, sponsored by the Virginia Council on Family Relations, is to determine current policy at the State and local levels. Analysis is made of the returns obtained from a questionnaire sent to all school principals in Virginia, and to all P.T.A. units, where they were asked to indicate which of a variety of topics in sex education are presently being taught, are not being taught, and which they do not wish to be introduced into the curriculum. Differences in attitudes of parents and educators toward sex instruction in public schools will be pointed out.

6. NON-SEX BEHAVIOR CHANGES INDUCED BY AN ESTROGEN.

Robert L. Rhyne; *University of Virginia*

Mature male albino rats had free access to food, water, and revolving activity drums under a 12 hour dark-12 hour light cycle. Following three subcutaneous injections of estradiol benzoate (0.25 mg every other day) food consumption was drastically reduced and somewhat depressed throughout the recovery period; water consumption was less markedly depressed, while rotor wheel activity evidenced both variable and inconsistent changes. Maximal weight losses under the drug effect ranged from 2 to 12 percent of body weight. The present results suggest that an estrogen has conspicuous motivational "side effects" besides the "sex behavior" properties classically ascribed to this kind of hormone.

7. CONSTRUCTION AND EVALUATION OF A MODIFIED FORM OF THE IOWA PICTURE INTERPRETATION TEST.

David G. Rice; *College of William and Mary*

The Iowa Picture Interpretation Test (IPIT) was modified by placing all multiple-choice responses along an achievement imagery (AI) scale, instead of the hostility, insecurity, bland and AI response scales used for each picture in the original IPIT. There was no difference between high and low academic achievers on this form, using a criterion of grade average in excess for below predictions from an entrance test. A second criterion showed similar negative results. Item analysis suggested that the measure could be improved by reweighting the items, whose original weights had been assigned on the basis of judges' ratings to various response sentences.

8. A SECOND REPORT ON ACHIEVEMENT IMAGERY AND A. C. E. SCORES AS PREDICTORS OF GRADES IN GENERAL PSYCHOLOGY.

John E. Williams; *University of Richmond*

The academic performance of four hundred students in general

psychology was studied in relationship to scores on the A. C. E. Test – a measure of scholastic aptitude for intelligence – and scores on the Achievement Imagery scale of the Iowa Picture Interpretation Test. The IPIT is a multiple-choice form of the T. A. T. The main finding was that high Achievement Imagery exerts a beneficial effect on academic performance at low and average levels of intelligence but produces no effect among students in the highest quartile of intellectual ability. It was concluded that the results of this study should encourage attempts to devise objective measures of non-intellectual factors influencing academic performance.

9. THE EFFECT OF FAILURE AND ACHIEVEMENT IMAGERY ON ARITHMETIC PERFORMANCE.

R. A. Johnston; *University of Richmond*

The purpose of this investigation was to replicate an earlier study by Williams which showed differential response to failure by groups differing in Achievement Imagery and secondly to investigate the capacity of the Insecurity Scale of the Iowa Picture Interpretation Test to predict response to failure. For one-half of the subjects failure was induced by telling them they had not reached goals which they, themselves, had set and one-half were told that they had failed to reach goals set by the experimenter. The results sugested that both the Achievement Imagery and Insecurity variables were related to performance following failure and that the responses of these groups were dependent on whether the goal setting was done by the subject or the experimenter. It was also pointd out that the actual performance of subjects following failure was not well understood.

10. VISUAL FEEDBACK AS A VARIABLE IN A HUMAN PUZZLE BOX SITUTION.

Henry A. Schwartz; *College of William and Mary*

This experiment was designed to determine the effects of four different amounts of visual feedback on latency, amplitude, rate and stereotypy measures of a motor operant response in humans. Subjects were required to learn to trace a path with a pen to a location on a sheet of paper. Each S was scored for latency, length of line traced and amount of stereotypy exhibited during 15 acquisition trials. Visual feedback was found not to affect any of the measures taken. It was found that the classical measures of latency, amplitude and rate did not adequately describe the behavior in this situation.

11. AF: A NEW APPROACH TO THE CONCEPT OF ACHIEVEMENT.

Robert M. Roth and Jean Gilbert; *Hampton Institute*

This study tested the hypothesis that the Achievement Factor (AF),

the relative difference between a student's aptitude and achievement in the verbal and quantitative areas, could be used as a valid indicator of academic success at Hampton Institute. Aptitude and Achievement test scores were correlated with grades at the end of the first semester for the class of 1960. The results indicated that the level of relationship was inadequate. Significance was achieved when AF was related to grades. There was a sex bias in these results. It was indicated in this study that academic achievement is related to personality factors and that much more research is necessary in this area. The AF concept is a suitable approach to this end.

12. INVESTIGATION OF THE EFFECTS OF A BRIEF LIGHT STIMULUS CONTINGENT UPON A RESTRICTED VERBAL OPERANT IN HUMAN SUBJECTS.

John R. DeWilde; *College of William and Mary*

The effects of a brief light stimulus contingent upon plural noun responses were studied under three experimental conditions: light deprivation, making a consumatory response to the light, and presence or absence of the experimenter. Seventy-nine undergraduate subjects were seated individually in a sound resistant room and instructed to say words. Following operant level determination experimental subjects received the light stimulus for plural nouns. Control subjects received either no light or light presented randomly with respect to the words emitted. The results failed to confirm previous studies which have shown that a brief light stimulus will reinforce verbal operant behavior.

13. THE "DOCTOR OF PSYCHOLOGY" AS A PROFESSIONAL DEGREE.

Dell Lebo; *Child Guidance and Speech Correction Clinic,* Jacksonville, and Leland W. Calvin, Jr.; *Richmond Professional Institute*

There has been agitation in psychological journals to abandon the academic PhD and confer a professional doctorate in psychology, PsyD or PsD. Psychologists should be aware that the Doctor of Psychology degree has been available to charlatans for approximately 35 years from state chartered organizations. Doctorates from rigorous training programs may become confused with similarly worded degrees lavishly bestowed upon completion of bizarre course requirements. Professional relationships are jeopardized. The number of such peculiar establishments is increasing; eight are cited and the requirements of four are examined. Methods of distinguishing between bona fide diplomas and suspicious ones are presented.

14. DIFFERENTIAL DRUG EFFECTS ON SCHEDULES OF REINFORCEMENT IN THE PIGEON.

Arthur J. Bachrach and Janice Gibson;

University of Virginia School of Medicine

Using each bird as its own control, a Carneaux pigeon receiving 0.4 mg. methamphetamine hydrochloride decreased its pecking rate during both FR and FI schedules in a Skinner box, while one receiving 0.1 mg. methamphetamine hydrochloride increased its pecking rate. 3 mg. pentobarbital sodium returned the first bird to its normal rate of response while 1 mg. pentobarbital sodium decreased the rate of the second bird. To answer the question, "Does appetite loss cause the lower pecking rate after a large dose of methamphetamine?", both birds were fed ad libitum with and without methamphetamine injections. The amount of weight gain appeared the same.

15. ASSESSMENT AND EXTENSION, AND TEST OF OEDIPUS CONCEPT.

John T. Blue, Jr.; *Norfolk Division, Virginia State College*

The elements and construction of the Oedipus concept were assessed and the conceptualization was extended. More complex hypotheses were tested by using a questionnaire. The sample consisted of 606 white and Negro Southern adolescents with native-born parents. The incidence of patterns of reciprocation between each parent and the child on several axes of relatedness was determined, taking account of sex, race, and social status. Differences between mothers and fathers were found significant on all axes. Differences between mothers (as well as fathers) of children who differed by sex, race, and social status were noted. Tests of significance were applied, taking into account one factor while holding constant two other factors. The differences between mothers and fathers were significant when sex, race, and social status were taken into account. On certain axes of relatedness, sex, race, and social status differences emerged.

16. DRINKING BEHAVIOR AS A FUNCTION OF SALINE INJECTIONS AND WATER DEPRIVATION.

James F. Campbell, Jr.; *University of Virginia*

Rats were either injected with different concentrations of saline and denied access to water for intervals up to an hour, or were deprived of water for 24, 48, or 72 horus. Drinking during a two hour test was cumulatively recorded with an electronic drinkometer. The total amount drunk and the initial period of uninterrupted drinking increased with increasing deprivation and, except for the highest, with increasing concentration. Under deprivation the number of subsequent drinking periods remained constant, but the amount consumed increased with deprivation. With injection, although the amount consumed during subsequent periods increased with concentration, the number of periods varied with delay and concentration.

17. THE PRESENT STATUS OF RECORDED SOUND STIMULI ASSOCIATION TESTS

Dell Lebo; *Child Guidance and Speech Correction Clinic*, Jacksonville, and Roselyn Sherman Bruce; *Social Service Bureau, Richmond*

The development of auditory projective techniques, all requiring recorded stimuli, for use with the blind is traced. The nature of the growth is regarded as dangerous and criticized. Specific suggestions for improvement range from a standard titling procedure to a fundamental research program. Much of the recommended experimentation on the dynamic meaning of sound stimuli can be jutifiably conducted by means of associations to written words or sentences. It is pointed out further that diagnostic nuances may be overlooked by dependence on a TAT scoring system and that techniques developed to tap different sensory modalities should merit original scoring procedures.

18. A COMPARISON OF SCIENCE AND NON-SCIENCE STUDENTS ON THE MORGAN TEST OF LOGICAL REASONING.

Fred McCoy; *University of Richmond*

A report by Morgan before the Academy last year showed selected young scientists to get extremely high scores on the Morgan Test of Logical Reasoning. This study is a test of the hypothesis that scientists and non-scientists differ in logical reasoning ability and can be discriminated by the Morgan test. 95 college students were given the Morgan Test. Logic scores were found to be significantly related to intelligence. Holding intelligence constant by analysis of covariance, there was no difference in logic scores between (1) men and women in the sample, and (3) three age groups in the sample. There was, however, a significant difference between people who had had an academic course in logic and those who had not. 48 (forty-eight) seniors, none of whom had taken a course in logic were divided into three groups: (1) science majors (chemistry, physics, biology); (2) non-scientist majors (English history ,bible, music, languages, drama, and physical education); and (3) mathematics majors. And each of these three groups was compared at three levels of intelligence. The results showed that math majors were superior in logic scores to both scientists and non-scientists, who did not differ from each other. On the lowest level of intelligence, there was no difference between the three majors, but this interaction was not significant.

19. A DISCUSSION OF CONCEPTS OF PLAY.

Jacob Silverberg; *Veterans Administration*

The theories of play which have been advanced in our present culture and which assume that it is an activity solely relegated to the world

of the child, that because it is not work it is not serious activity, are distorted representations of behaviors which are seen here as vital in creating prototype situations for the child, as well as for the adult, in mastering reality and contributing to the development and creative growth of *identity*. That Western civilization has been increasingly losing its "playful" character is menacingly apparent. It is the interplay of work and play, rather than their disjointed separateness which can be most conducive to human development.

20. NINE YEARS OF DIAGNOSIS AND TREATMENT AT THE LYNCHBURG COLLEGE READING CENTER.

William D. Brown and Louann Bolden; *Lynchburg College*

From 1949 through 1958 two-hundred and thirty subjects were diagnosed and/or given instruction to help alleviate their reading deficiency by the Lynchburg College Reading Center. From data supplied by the files at the Center and questionnaires answered by the parents, a survey was administered concerning the value and help given by the Center. Emotional, educational, and physiological factors were considered, as they contribute to reading problems. However, these factors are complex and remedial reading instruction is more effective when undertaken in conjuction with consideration of distrubances in other areas of human functioning.

21. DETECTION AND RECOGNITION THRESHOLDS OF NON-UNIFORM VISUAL TARGETS.

E. Rae Harcum; *College of William and Mary*

In three target surfaces a unit of surface microstructure was black or white depending upon whether it was different from the brightness of the adjacent preceeding unit in an arbitary sequence 100, 75, or 50% of the time, respectively. Previous research found lowest detection thresholds for the 50% (random) microstructures, and highest thresholds for the 100 % (checkerboard) surfaces, but frequently the reverse for recognition thresholds. Present preliminary results suggest that whether thresholds vary significantly as a function of target surface microstructure is dependent upon: (a) target area; and (b) observer's criterion level for detection or recognition.

22. THE LOWRY REASONING TEST COMBINATION AS A STATUS-FREE DEVICE FOR A PERSONNEL SELECTION PROBLEM.

R. S. Andrews; *QM Field Evaluation Agency*, R. O. Lucier; *Courtney and Co.*, and Dell Lebo; *Richmond Professional Institute*

The Lowry Reasoning Combination (LRC) and portions of the

Army Classification Battery (ACB) were evaluated to determine relative efficiency for identifying the maximum number of individuals capable of satisfactory performance on a job requiring above-average intellectual functioning. The method of equal-appearing intervals was adapted to the development of a performance rating form which was used by supervisors to rate job incumbents. Application of appropriate statistical techniques to the results indicated that the LRC is most efficient in predicting job performance, least influenced by level of education, and provides a simple, relatively status-free device for personnel selection.

23. COUNSELING WITH A GROUP OF MENTALLY RETARDED CHILDREN IN A PUBLIC SCHOOL SETTING.

Cora Lynn C. Goldsborough; *Arlington County Schools*

The class in which these counseling sessions took place was a group of educable mentally retarded children at the intermediate level in an elementary school. The class consisted of a mixed group of boys and girls whose ages ranged from ten to thirteen years. The purpose of the sessions was to discuss and encourage better social adjustment, looking towards the transition to classes in a junior high school The sessions were held on a regular weekly basis for a half hour with the school psychologist as leader and the teacher as an aid. A variety of techniques was employed to maintain the children's interest and participation and to reenforce the point brought up. In addition to discussion use was made of role playing, picture drawing, chart making, and real life situations. Their teacher who sat in on the sessions continued a carry over of points made during the intervening week. Over a six months period definite changes of attitude within the group towards each other were noted as well as a carry over into a better handling of social situations out side the school situation.

24. THE OLFACTORY SENSITIVITY OF THE RAT TO SOME HOMOLOGUS HYDROCARBONS.

William R. Goff; *University of Virginia*

The sensitivity of albino rats to the odors of three homologous, saturated hydrocarbons has been measured using a previously reported olfactometer. Odors are presented by injecting them into an air stream flowing continuously through a "wind tunnel" response chamber in which the animal is bar pressing. A discrimination is established between presence and absence of odor in which presence of odor signals cessation of response. Training is continued as concentration is progressively lowered until discrimination fails. If the ratio of responses during odor to responses during a non-odor control stimulus is plotted as a function of log

concentration, the result is a linear function which expresses the sensitivity of the animal.

25. TRAITS BY FIAT.

Henry E. Garrett; *University of Virginia*

Categories of behavior are often set up intuitively and are then described by test items which seem "logically" to measure them. Often these behavior categories are treated as though they constituted specific and well established trait dimensions. Unless the independence of such hypothesized traits can be demonstrated experimentally, however, vocational or educational advice based upon apparent differences among them will be useless if not definitely misleading. Illustrations of "fiat" traits are given.

SCIENCE TEACHERS

1. SETTING AND MAINTAINING STANDARDS IN TODAY'S SCHOOLS.

Franklin D. Kizer; *Assistant Supervisor of Secondary Education*

The State of Virginia has been alloted, under the National Defense Education Act, $466,360 for the current fiscal year for the acquisition of equipment. This is to be matched, dollar for dollar, by local funds. Mr. Kizer discussed the requirements that must be met in order to receive such funds and the equipment allowed and explained the procedure which should be employed when applying for aid.

2. WHAT THE VIRGINIA JUNIOR ACADEMY OF SCIENCE HAS MEANT TO ME.

Joanna Hackman; *Hollins College* and Robert Dunning; *University of Richmond*

Miss Hackman, a 1953 graduate of Radford High School, praised the Virginia Junior Academy of Science for the interest, opportunities, encouragement, and guidance which it gave her as a high school student. She also gave a sketch of the work she has done on her project while in college and of the awards she has received since her high school days.

Mr. Dunning, a 1953 graduate of Norview High School, told how the Virginia Junior Academy of Science gave him an incentive to undertake his first project and how meeting and talking with senior members of the Academy has helped him in his work.

3. RESEARCH AND TECHNIQUES TO RAISE THE LEVEL OF INSTRUCTION IN PHYSICS AND GENERAL SCIENCE.

Edward North; *Washington and Lee High School*

Mr. North's objective is to teach physics to as many students as possible. He does not believe "in bending the course to suit the student but rather to bend the student to fit the course." He stated that he sells his physics course on how "tough" it is.

Some of the techniques which Mr. North stressed are:

1. Extra-curricula activities should be related to classwork.
2. Classroom work must be the most important part of a course.
3. Laboratory manuals and textbooks should be used only as reference books.
4. The number of experiments should be reduced and the experiments used should cover a large area. Data obtained from previous experiments should be used.
5. Students should be screened and the special ones put into one class.
6. Classical physics should be taught.
7. A science teacher should have only four classes and no homeroom.
8. Algebra and science clasess should be correlated.
9. There should be a follow-up study of students to see how effectively their science courses prepared them for their college work or their jobs.

4. RECENT ADVANCES IN CYTOLOGY.

Henry G. Kupfer; *Department of Clinical Pathology, Medical College of Virginia*

Dr. Kupfer spoke of the necessity of laboratory work in medicine. He discussed the field of medical technology as a career and explained the training required, the opportunities, and the need for trained people in this field. A film, "The Human Cell and the Cytotechnologist," was shown.

5. THE ROLE OF THE VIRGINIA DEPARTMENT OF AGRICULTURE AND IMMIGRATION IN THE ECONOMIC GROWTH AND DEVELOPMENT OF VIRGINIA.

Parke C. Brinkley, *Commissioner, Medical College of Virginia*

Mr. Brinkley explained the opportunities that face young people today in the field of agriculture. When young people leave the farm they need not leave the field of agriculture for science has now become an

important part of farming. He stated that there are 15,000 job openings per year in fields related to agriculture and only 7,000 degrees in agriculture granted per year.

BUSINESS MEETING.

The following officers were elected for the coming year: A. B. Niemeyer, Jr., *Chairman;* Virginia C. Ellett, *Chairman-Elect;* and Robert Horne, *Secretary.*

STATISTICS

1. APPLICATIONS OF COMPUTERS TO MEDICAL RESEARCH.

Frank W. Banghart; *University of Virginia*

Presentation of the results of three conferences held by the Air Force on the applications of computers to medical research. Topics will include applications of computers to brain functions, cellular activities, electrocardiography, electroencephalography, surgery, liver functions, insulin coma, psychiatric disorders, and hemodynamic systems.

2. LINEAR PROGRAMMING APPLICATIONS.

Norbert Lloyd Enrick and Sue Champney Lawrence; *Institute of Textile Technology*

Linear Programming is a relatively new technique of mathematical analysis, which permits the selection of an optimum combination from a series of interrelated and interacting alternatives, each subject to limitations; as encountered in many industrial, economic and military problems. Investigative work at the Institute has been with regard to the industrial potentials of this tool, and several successful applications have been made, using an electronic computer (Burroughs Electro-Data E-101-3) to perform the actual calculations. An illustrative example, shows how the Simplex and Ratio-Analysis methods of Linear Programming may be used to develop an optimibed solution. The example given is coded. Parallel applications of this technique to problems in industry in general becomes apparent.

3. TRAFFIC VOLUME ESTIMATES PROBABILITY APPLICATIONS.

Marvin Tummins; *Virginia Council of Highway Investigation and Research*

The average daily volume of traffic moving over a particular high-

way during the year, commonly called ADT, is a measure of service of that highway and thus is of particular importance. Also, in order to administer highway activities and to evaluate requirements, information about characteristics other than volume is needed. True values of ADT are difficult if not impossible to obtain. Continuous counting for 365 days is made almost impossible by various defects arising in mechanical counters. Estimating procedures thus are made necessary. Probability techniques could result in estimates with measurable accuracy and precision and could combine estimates of volumes with estimates of other characteristics. In this study various probability applications are tried, tested for accuracy and precision, and then the various applications are compared. Each estimate is compared against known results. The emphasis is upon the use of small samples — 10 to 15 observations.

4. NOTES ON THE DETECTION OF WEAROUT.

C. W. Clunies-Ross; *Virginia Polytechnic Institute*

The exponential distribution may be characterized by the fact that the conditional "failure" rate is constant, i.e., lifetimes are distributed as the waiting time for the initial disturbance from a Poisson process the parameter of which is constant. One method of allowing for (irreversible) wearout is to consider the underlying Poisson process as one whose parameter is an increasing function of time. This paper investigates two statistical properties of such wearout. One property is that the differences between ordered observations which, with suitable multipliers, are independent, and identically distributed for the exponential distribution now form a stochastically monotonic, non-independent sequence. Another property is that the standard deviation is less than the mean. Statistical tests of these properties are proposed and discussed in general terms. Empirical sampling results are used to estimate the power of the tests for certain examples. Matched sampling is employed; this allows the use of stratified estimators for the estimation power.

5. A COMPARISON OF THE INTERNAL AND EXTERNAL ASSAY VARIATION IN THE VIRULENCE TESTING OF BACCILLUS ANTHRACIS SPORES.

Ira A. DeArmon, Jr.; *Fort Dietrick, Maryland*

Triplicate quantal response assays each using 40 mice were performed with each of eight strains of *B anthracis* spores by both the intraperitoneal and subcutaneous routes of challenge. The observed variances of the LD_{50}'s (internal) were contrasted to the variances between repeated LD_{50}'s (external). The external variance was homogeneous for the treatment conditions and was approximately 4 fold larger than the mean internal variance. It was concluded that the virulence of a strain of *B anthracis* spores can best be estimated by repeated LD_{50}'s based on

a small number of animals rather than a single LD_{∞} determined from a large number of animals.

6. NOTE ON PRECISION OF GRADED VS ALL-OR-NONE RESPONSE IN BIOASSAY

F. M Wadley; *Fort Dietrick, Maryland*

Graded and all-or-none responses are compared on a theoretical basis; for equally well adapted responses, we should expect the former to be a little over twice as precise. Examination of several cases supports this idea. Relative precision in an actual experiment may be compared by use of the variances. If one response is used, the precision necessary to match it for the other response can be estimated.

7. MULTIVARIATE SFQUENTIAL PROCEDURES FOR TESTING MEANS. (PRELIMINARY REPORT.)

J. Edward Jackson; *Virginia Polytechnic Institute*

Let $\underline{x} = [\mu_1 - \mu_{10} \quad \mu_2 - \mu_{20} \ldots\ldots\ldots \mu_p - \mu_{p0}]$ Where μ_i is the true mean of the ith variable in a p-variable situation and μ_{10} is the hypothetical or standard value for the ith variable. Sequential tests are proposed to test the typothesis

$$H_0 : \underline{x}\underline{\Sigma}^{-1}\underline{x}' = 0$$

against the alternative hypothesis

$$H_1 : \underline{x}\underline{\Sigma}^{-1}\underline{x}' = \lambda^2$$

both for the case where the population corvariance matrix Σ is known and the case where it must be estimated from the sample. The standard type of sequential test procedure is to continue sampling when

$$\ln [\beta/(1-\alpha)] < g_n < \ln [(1-\beta)/\alpha],$$

accept H_0 if $g_n < \ln [\beta/(1-\alpha)]$ and accept H_1 if $g_n > \ln [(1-\beta)/\alpha]$.

If $\overline{\underline{x}} = [\overline{x}_1 - \mu_{10} \quad \overline{x}_2 - \mu_{20} \ldots\ldots \overline{x}_p - \mu_{p0}]$, $\chi^2 = n\overline{\underline{x}}\underline{\Sigma}^{-1}\overline{\underline{x}}'$ and $T^2 = n\overline{\underline{x}}\underline{S}^{-1}\overline{\underline{x}}'$, then for the case when Σ is known

$$g_n = -n\lambda^2/2 - \sqrt{n\lambda^2 \chi^2} + \ln {}_1F_1 \quad (p-1)/2, p-1; 2\sqrt{n\lambda^2 \chi^2}$$

and where Σ is now known,

$$g_n = -n\lambda^2/2 + \ln {}_1F_1[n/2,\ p/2;\ (n\lambda^2 T^2)/2(n-1+T^2)]$$

where ${}_1F_1[a, b; x]$ denotes a confluent hypergeometric function. Similar multivariate sequential tests are also derived for the problem of comparing the means of two samples.

8. ON COMPARING DIFFERENT TESTS OF THE SAME HYPOTHESIS.

H. A. David: *Virginia Polytechnic Institute*

D. R. Cox (Biometrika, 1956) sugested that a quïck test should be compared with the corresponding standard test not only on the basis of power but also on the extent to which the quick test leads to the same conclusion as the standard test. Two approaches to such a comparison are considered in the present paper, namely the evaluation of: (1) The probability of establishing significance at a certain level with the quick test given that the standard test is *just* significant at some more stringent level; and (2) The probability that the quick test statistic will exceed its conditional expectation given a specified value of the standard statistic. It is shown that these two probabilities are under suitable conditions independent of the parameter θ under test. For example, it is sufficient that the standard statistic be a complete sufficient statistic for θ. The theory is applied to a comparison of the sample standard deviation, range and mean deviation as tests of variance in the case of a normal parent.

9. A STUDY OF MULTIVARIATE CONFIDENCE BOUNDS.

Rolf E. Bargmann; *Virginia Polytechnic Institute*

The present report discusses the construction of confidence bounds in three standard cases of multivariate analysis. After generalizing certain types of univariate distributions, we proceed to show that exact confidence bounds are available on some not too useful parametric functions, whereas the present approach does not succeed in determining the exact bounds of functions which are the parametric analogues of likelihood-ratio statistics.

10. TWO WAY RANK SUM TESTS FOR VARIANCES.

Abdur R. Ansari and R. A. Bradley; *Virginia Polytechnic Institute*

This paper deals with non-parametric two-sample tests of variances. We have proposed a test based on statistic W. In the paper a recursion

formula for probabilities in the exact distribution of W have been developed; tables for the exact distribution of W have been prepared for the combined sample sizes m and n up to 20, and higher order moments of W have been derived. A study of a normal approximation and a Pearsonian approximation to the statistic W has been made. The kurtosis and skewness of W indicate that for large sample sizes, the distribution of the statistic W approaches the normal curve. The asymptotic normality of W has been established, and its relative efficiency in the Pitman sense, as compared with the usual variance-ratio F-test, has been derived. We have also modified our statistic W. Later different procedures available in the literature have been compared showing the advantages and disadvantages of the test-statistic W and an example has been furnished to illustrate its use.

11. A COMPARISON OF THE EFFECTIVENESS OF TOURNAMENTS.

W. A. Glenn; *Virginia Polytechnic Institute*

Round robin, replicated knock-out, and double elimination tournaments (in which players are eliminated after two losses) are investigated for their efectiveness in selecting the best one of four players. The criteria proposed for the comparison are (a) the probability that the best player wins (after play-off if necessary) and (b) the expected number of games required for the determination of a winner. For general values of the parameters which characterize the system expressions are derived for the evaluation of the criteria. Comparisons are then made on the basis of series of assigned parameter values. The possibility of extending this investigation to cases involving a larger number of players is discussed.

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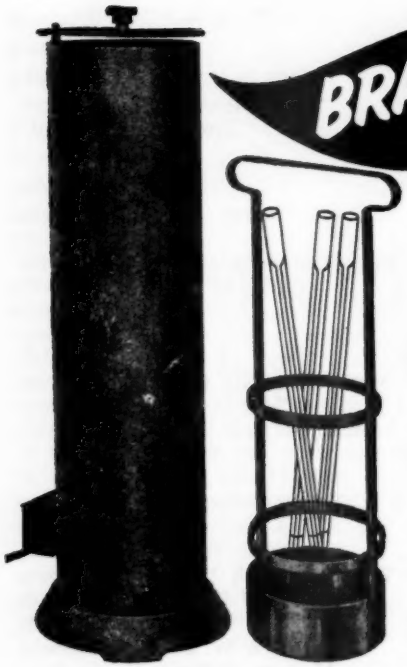

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